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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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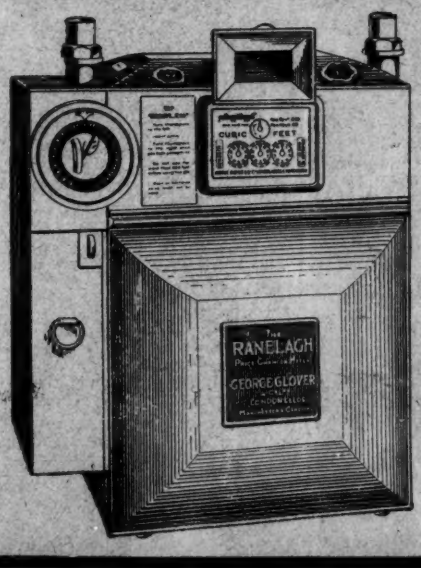

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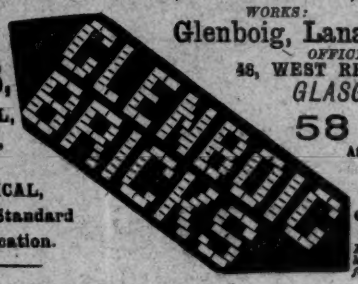

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VOL. CLXII., No. 3130.] WEDNESDAY, MAY 9, 1923. [75TH YEAR.

EDITORIAL NOTES.

Parliamentary Committees and Gas Price Fixing.

THE gas industry sincerely wishes that Parliamentary Committees would adopt some settled policy as to the fixing of therm prices, so that promoters may definitely know whether or not it is of any use inserting proposals in Bills, or whether they must proceed by application for an Order through the Board of Trade. Also whether it is any use including standard or maximum prices on the per 1000 c.ft. basis, or whether, the time having passed when the Board of Trade can (if they think fit) compel all statutory undertakings to come under section 1 of the Gas Regulation Act, the prices suggested must be on the therm basis. In other words, are Committees henceforth going to refuse to agree to prices on the volumetric basis? If this last question is answered in the affirmative, and it is considered desirable that all therm prices must be settled by the Board of Trade, then it simply means that the machinery set-up by the Gas Regulation Act is the only operative means by which standard and maximum gas prices will in future be authorized, and the therm basis the only one that will be adopted. We submit these questions because of two fresh decisions. Recently the Unopposed Bills Committee of the House of Commons announced that they would not agree to any proposals for therm prices, unless they were satisfied that all relative matters in respect of costs had been threshed-out by experts, and an agreement come to between the promoting company and the local authorities; and now we have, in the case of the Rawmarsh District Council Bill, the Local Legislation Committee deleting the maximum price proposals of 5s. 9d. up to 44,500 c.ft., and 5s. 6d. beyond, which are the wartime sanctioned charges. These it was desired to maintain, in order that the undertaking might right itself, in view of the bad times through which it has been passing, including a destructive explosion at the gas-works. The discussion of the matter, as reported in our "Parliamentary "Intelligence," indicates that the Committee are of opinion that the question of gas-price fixing is now, under the general law, one for the Board of Trade. But, as we say, it is highly advisable that the parliamentary authorities should arrive at, and make an early pronouncement as to, some settled policy respecting this matter. It would be much more satisfactory to all concerned.

The decision of the Unopposed Bills Committee to accept therm prices that have been settled, through examination and discussion of cost items, by experts representing the gas suppliers on the one hand and the gas consumers on the other, could hardly apply to a local authority who are the gas suppliers as well as the representatives of the ratepayers. In such a case, it is not likely there would be an expert representing gas consumers in opposition, unless a railway company or the industrial consumers took-up the matter. This being so, the rule of the Unopposed Bills Committee would mean a reference to the Board of Trade.

Then as to the refusal of the Local Legislation Committee to deal with the Rawmarsh Council's maximum prices per 1000 c.ft., this means that the authority will now have to apply for an Order to the Board of Trade, as their right to the present charges will expire in a few weeks' time. The only power that the Board of Trade now possess in the matter of fixing prices is under the Gas Regulation Act, and by the therm form. Parliament, the Fuel Research Board, the Board of Trade, the Gas Referees, and (with the accrued experience) the absolutely impartial Therm Charges Committee are all agreed that the statutorily controlled gas industry should be brought on to a common basis in respect of charging by heating value; and the Gas Regulation Act is (whatever may happen in the future) to-day the last word and legislative decree in this connection. The Local Legislation Committee were so anxious to obtain proper guidance as to the course they should pursue in regard to the Rawmarsh application to have the war-time maximum prices continued on the 1000 c.ft. basis, that they asked the Director of Gas Administration (Mr. H. C. Honey) to attend the first sitting in order to learn the views of the Board. As he then pointed out, the Gas Regulation Act not only sought to give to the gas industry a comparable method of charging, but it aimed at co-ordinating the system of testing and minimum pressure provision throughout the statutory gas supply. In view of the fact that the very first recommendation of the Therm Charges Committee was that the method of charging for gas on the thermal basis should be extended to all gas undertakings coming within the scope of the Act, Mr. Honey says the Board of Trade do not feel that they ought to agree to such an undertaking as the Rawmarsh one remaining under the old system of charging any longer than is absolutely necessary. He added, too, that the Board are unable to understand why, when the Rawmarsh Council are proposing to increase their maximum prices, they should desire to continue to charge by volume. The Board are willing to consider anything submitted to them as reasons for allowing special terms under special circumstances; and what is more they are quite at liberty to give the Council time to set their house in order under a maximum price which would not be allowed to continue indefinitely, and so would not be regarded as a normal maximum. In one place, Counsel for the promoters seemed to cast a little reflection on the intelligence of the Rawmarsh District Council. He argued that he did not think that, merely because the Council asked for an increase of the maximum charge, the opportunity should be taken to change from a system of charging which they understand to one which they do not understand. At the time of the therm inquiry, it was officially stated that "more than" 60 p.ct. of the gas supplied by statutory gas undertakings was now charged for on the therm basis; so that probably the figure is to-day nearer 70 p.ct. than 60 p.ct. And yet, according to learned Counsel, his Rawmarsh clients, with all the large application of the system, do not understand it! We cannot credit the statement; but, if it be true, it ought not to take the members of the Council long—assuming a reasonable amount of intelligence—to understand it given a little proper tuition, and providing that they can do simple multiplication and division sums.

However, that by the way. From what has been said here, it will, we think, be agreed that the tendency in legislative quarters—though nothing definite has been announced officially—is to refer all the work of standard or maximum gas-price determination to the Board of Trade, and to refuse longer life, when applicants are in Parliament, to the system of charging by cubic feet. In our opinion, the tendency is correct, but an authoritative pronouncement would be a valuable guide. To such a pronouncement we think the industry is entitled.

Calorific Value.

When Dr. W. B. Davidson reads a paper, writes an article, or does anything else in the way of literary work treating of technical subjects, one always expects to find in it something original. In the paper on "Calorific Value" which he read before the North of England Gas Managers' Association on Friday last, there was not disappointment. Dr. Davidson has in his chemical and physical investigations worked by well-known methods; but he has never allowed himself to be tied by them if he has found any inadequacy, and the way to improvement. And he is very critical of both apparatus and methods, which is the right attitude in all scientific examinations. In this contribution, he takes us over much ground—giving, in the first place, some information as to the calorific values of food and other materials, and then on to the fuels in which we are as an industry interested—coal, coke, and gas. No one will read the paper without being impressed by the fact that, if we buy and sell our fuels on a calorific basis, we shall get and give better values for money, and both courses are very desirable in business.

Take coal for example. It has been advocated by Sir George Beilby and others that, even for gas making, coal should be purchased on a calorific basis; but volatile matter, and freedom from ash and moisture, are also important. They must not, however, be regarded—as some gas engineers do regard them—as being of supreme importance. As Dr. Davidson points out, the principal criterion of the gas-making quality of a gas coal is the content of available hydrogen. This is tantamount to recognizing that the higher the calorific value, the better the coal for gas manufacture. For this reason, he strongly advocates the use in the valuation of gas coals of the calorific value test, in addition to the ordinary tests for proximate analysis. Given comparability of ash and moisture in two cases, the test for calorific value will supply a good indication as to which is the better gas coal—that with the larger amount of available hydrogen giving the higher test-figure. There are comparatively few gas-works laboratories where anything more than a proximate analysis is made of the gas coal purchased; but Dr. Davidson makes out a good case for the calorific test becoming a general practice where it can be carried out. For those who have not had experience in this direction, much useful information will be found in the paper. Various apparatus is referred to; but there is no doubt that the author has a preference for the Mahler-Cook bomb. Explanation is furnished as to how a determination is made; and directions and sequence for the actual performance of a test are given. If one follows these, there can be no failure in obtaining accurate results. In the bomb, determinations can also be made of coke, tar, oils, and all kinds of fuels. Dr. Davidson holds that it is quite a reasonable proposition to buy and sell not only coal but coke and coke dust on a therm basis. But more information as to their calorific values would be very useful to buyers of these latter fuels. As our opening notes in "Electricity Supply Memoranda" this week show, even the Electricity Commissioners have somewhat crude ideas as to their actual values. A number of years ago, Mr. G. M. Gill protested strongly against coke breeze being sold at prices that were not equivalent to its thermal value. But it is still being done; and extraordinarily low prices are being accepted. In the paper, an instance is supplied: "Clean coke dust with a "calorific value of about 11,000 B.Th.U. per lb., has been "advertised in this district recently at the ridiculous price "of 1s. per ton on rail, or 0·05d. per therm." The use of the descriptive term "ridiculous" is more than justified; seeing that, structural arrangements being suitable, this coke dust can be burned under boilers with profitable results—and the more profitable, the lower the price at which the buyer is successful in purchasing the fuel. Of course, it requires to be used in a way which will produce a good efficiency; and one of the best methods is Nicol's patent "Sandwich" system.

Then we come to another point. Dr. Davidson has the boldness to question the legitimacy, in testing for calorific value for making charges on the therm system, of correcting to 60° Fahr. and 30 in. bar. In his opinion, gas engineers have a perfect right to complain of some of the old testing conditions, and especially this one, in view of the fact that the mean temperature of the gas, delivered at the meters in consumers' houses, is about 45° to 48° Fahr. As moist gas increases in volume approximately by 1 p.ct. for a rise of 4° Fahr., it follows that the gas supplier is deprived of a legitimate 3 p.ct. In other words, the author holds the view that the gas consumer, on the average, is actually receiving 3 to 4 p.ct. more in therms than he is entitled to, and this over and above the extra advantage he gets in that the test value is necessarily higher than the declared value (to avoid penalty). At 60 therms per ton of coal, and 6d. per therm, 3½ p.ct. is equivalent to about £1,000,000 per annum on the annual coal consumption at current prices. This is surely worth having. Dr. Davidson regards this point as an oversight on the part of the Board of Trade, seeing that the Fuel Research Board recommended that the consumer should be charged for the thermal units actually delivered in the same way as the consumer of electricity is charged for the Board of Trade units which pass through his meter. We do not suppose the Board really knew anything about the matter. They were no doubt advised in this particular by the gentlemen who are the Gas Referees under the Gas Regulation Act. Any change could now only be effected by an amending Act; and the persons who would have to move the Board of Trade in the matter would be the Referees. If they think well to do this, they will be interested in the opinion of Dr. Davidson that "to ascertain "the thermal units in the gas received by the consumer, the "test ought to be carried out under conditions representing "reasonably closely those prevailing in the district of "supply, without making any correction for temperature "or pressure." Put another way, to his mind the spirit of the Act is properly interpreted when the gas is tested under conditions that reasonably represent the gas actually delivered at the consumers' meters. That is to say, in a cool room, at whatever pressure the atmosphere may happen to have—actual, not corrected. As he remarks, in all cases there would be a definite gain to the gas undertaking in the matter of temperature. Where towns or districts are situated well above sea-level, there will be a slight loss due to pressure, amounting in Birmingham, for example, to 1 p.ct. But in every case, it will mean a net gain and fairplay.

There is criticism in the paper as to the different values found in gas literature, attributed by different people to the combustible gases—carbon monoxide, hydrogen, and methane—and then there follows a description of a new gas calorimeter of simple features. We imagine this is of Dr. Davidson's own devising, as he does not say who is the designer. It has three good attributes. There is the one of simplicity; nevertheless its practical theoretical efficiency is 99·9 p.ct.; and its cost is low. Towards the end of the paper, Dr. Davidson sketches the modern tendencies in the choice of calorific value declarations; and apparently he is among those who are looking to the introduction of cheap oxygen on a large scale for the toning-up of producer gas to a state which will satisfy all demands as regards price and efficiency. Now is the time, it may be truly said, for the gas industry to bestir itself, so as quickly to realize its proper functions in domestic and industrial life. These are the words with which Dr. Davidson concluded a paper highly appropriate to the times, and suggestive in every detail.

Corrosion and Other Deposits in Service-Pipes.

It would be a bad thing if, as the gas industry technically progresses, it did not get closer and closer to its ideals in respect of the conditions of gas supply. It must not, however, be overlooked that gains in economy and efficiency are usually only made with an accompaniment of new trouble; but the technical men of the industry would not be worthy of their positions if they allowed the latter to stand in the way to advance. We must expect, and be prepared to deal with, any attendant difficulties, providing the cost of doing so is not in excess of the net value realized; otherwise progress would always be retarded. Having made an economic gain, and if some trouble ensues, then one has to consider, and to find, means for eliminating or avoiding it. The gas profession is very much engaged at the present time upon the problem of how to produce the cheapest gaseous therms, having regard to local conditions in respect of coal availability and cost and the demand for gas and the secondary products. There are a variety of types of plants and processes from which to select, according to the method of manufacture countenanced by conditions. But with certain of the modern systems of manufacture, there has been an increase of corrosive constituents which are inimical to iron and metal work, and of compounds which

are liable to condense in a solid form in the distribution system, and so obstruct the free passage of gas. Mr. B. Richardson, of North Shields, has made a study of these matters; and his findings and conclusions are given in a paper which he read last Friday before the North of England Gas Managers' Association. It is, as will be seen by the reproduction of the contribution elsewhere in this issue, admirably concise.

From the facts set forth, the author deduces the causes of the troubles and their correction. It is elementary knowledge that corrosion is primarily due to the combined action of water, carbon dioxide, and oxygen upon the ironwork of mains; but to Mr. Richardson it appears that the deleterious effects of hydrocyanic acid in this connection have been somewhat over-estimated. But in saying this, he does not by any means suggest that the elimination of this impurity is not desirable. It is; for there is no doubt that it does considerable harm by augmenting corrosion, by coating the oxide in purifiers with prussian blue (thereby reducing its efficiency), and by fouling the water in the tanks of gasholders. In the paper, the author refers to experiments carried out for him by Mr. P. D. Scott, B.Sc., which show that, while town gas at the outlet of the holder contained 3·97 grains of hydrocyanic acid, at the most distant parts of the district the amount had fallen to 1·8 grains; so that about 55 p.ct. had disappeared as a result possibly of reaction with the ironwork of the services. The author refers to the polysulphide process of the British Cyanides Company as one of the most efficient and economical methods in use for dealing with the elimination of hydrocyanic acid. It is curious that in this connection he did not in the paper allude to the chalk process for the extraction of hydrocyanic acid which has been invented by Mr. J. G. Taplay, and patented by him and the Gas Light and Coke Company. It was reported at the last meeting of the Institution of Gas Engineers that in working this has proved successful; but as yet there are no definite particulars as to the results on large scale operation, to show whether in any way the activity of the chalk is interfered with, or any other difficulty arises.

However, Mr. Richardson finds from his investigations that corrosion deposits are most frequently found in those cases where excessive amounts of oxygen and carbon dioxide are allowed to go forward into the services, and where the gas does not contain sufficient hydrocarbons to form a protective coating upon the mains. The most obvious cure therefore is to limit the oxygen content of the gas to the absolute minimum, and to keep the carbon dioxide figure as low as possible by avoiding over-pulling, and consequent inclusion of furnace gas at the retorts. Another point which was emphasized is the advisability of practising complete ammonia recovery, as this compound forms, with carbon bisulphide, products which are corrosive to ironwork. The conclusions are quite in line with those from the research conducted on behalf of the Life of Gas-Meters Joint Committee, other than that perhaps in the latter hydrocyanic acid is regarded as having greater potency as a destructive agent than Mr. Richardson appears to concede.

As to naphthalene, Mr. Richardson prefers to wash this out of the gas with a suitable absorbent before it leaves the works; and the most satisfactory results he finds are obtained with a rotary scrubber. At Tynemouth, he uses water-gas oil as the stripping medium. In a 1½ million c.ft. per day rotary scrubber, he has treated 1¾ million c.ft. of gas per day; and, although the gas contains from 8 to 16 grains of naphthalene per 100 c.ft. at the inlet, it is quite free at the outlet. Under these conditions, the amount of oil necessary has been 35 gallons per million c.ft.; but when the scrubber has been worked well within its rated capacity—say, 1,200,000 c.ft. per day—the oil used has worked-out to as low as 16 gallons per million c.ft. The oil is afterwards utilized for carburetting water gas; and no increase has been found in the naphthalene content of the latter. As a matter of fact, in actual practice, the quantity of spent oil produced from the washer—250 to 500 gallons per week—constitutes only a small fraction of the total amount of oil consumed in the water-gas plant; so that it is invariably mixed with fresh gas oil to bring the naphthalene content down to 1 p.ct. or less. The water gas is not treated for naphthalene. The author, however, states that there is seldom present at the outlet of the condenser less than 12 grains per 100 c.ft.; but finally, when mixed with coal gas (the proportions are not stated), the distributed gas only contains about 0·8 grain of naphthalene per 100 c.ft. Naphthalene complaints are practically non-existent on the district, and this is testimony to sufficiency and efficiency. The net cost of the process works out at 0·133d. per 1000 c.ft. This is cheap enough in all conscience; and the price paid by the manufacturing department saves considerable expense in the distribution department, much worry and annoyance to the consumers, and much anxiety to the management. The "per contra" effects are worth considerably more than the 0·133d. per 1000 c.ft.

Gas-Fired and Waste-Heat Boilers.

A REMARKABLY instructive lecture on gas-fired and waste-heat boilers was delivered recently, by Major W. Gregson, to the London and Southern District Junior Gas Association. Both subjects are attractive to the technical men of the gas industry—the waste-heat boiler on the works, and the smaller units of gas-fired boilers on the district. We firmly believe that, after reading the lecture, many gas engineers of acute discernment will have their field of vision in the latter regard considerably enlarged. The lecturer first described the lines of evolution of the Spencer-Bonecourt "Kirke" boiler—starting with the original Bonecourt boiler, which quickly, in daily working, showed its ability to achieve a 90 p.ct. efficiency. Not only was this efficiency higher than anything previously attained in boiler practice, but the rate of evaporation on normal load was upwards of 20 lbs. per hour per square foot of heating surface. With such a performance, one might have imagined that perfection had been realized. We do not think that, with the improvements subsequently effected, the efficiency and the rate of evaporation per square foot of heating surface have been improved upon. As a matter of fact, the modifications that have been introduced have been directed to securing greater simplicity of control, and to allowing of a wide application of this type of boiler to the realm of industry.

Success has attended the efforts; and now there are two types of boilers, both of which, in their respective fields of use, should receive greater attention from the gas industry. The larger type—"K"—is designed to provide an output of 36,000 lbs. of steam per hour per single drum boiler, and 72,000 lbs. per hour per multi-drum boiler; while the "B" type is for small outputs up to 1500 lbs. of steam per hour. The overall efficiency of these units working on induced draught is approximately 90 p.ct.; with natural draught units—a higher outlet temperature having to be allowed—the efficiency of the smaller type boiler is reduced to the neighbourhood of 85 p.ct. Even this figure can only be attained by coal-fired steam-boilers magnificently equipped, and fed with coal of a generous quality; indeed, that efficiency figure has only been reached by coal-fired boilers under the most perfect of test conditions, and fitted with all the auxiliaries to economy. There is good authority for saying that the average efficiency of coal-fired steam-boilers is rather in the neighbourhood of 60 p.ct. than even the lower figure realized by the small type Spencer-Bonecourt "Kirke" boiler on natural draught.

The developments that have been made in gas-fired boilers are of considerable benefit to the gas industry. Every new outlet for business is welcomed; every method which is an advance on the old ways of doing things is an advantage. At the present time, town gas is too expensive for heavy steam generation; but for lighter service it is an excellent commercial proposition—particularly for intermittent requirements—with the "B" type boiler, and its efficiency of 85 to 90 p.ct. Naturally, as the price of town gas descends, so application is opened up to still larger steam-raising units. Major Gregson depicts a case which shows, compared with a coal-fired boiler, under the conditions mentioned, that there is a saving in expense each week, apart from the greater convenience, cleanliness, and steady head of steam at constant pressure throughout the working period. The saving apparently comes from labour; but, if there were no money saving, the attendant advantages would justify the use of town gas. These small boilers have been adopted for many trade and manufacturing purposes, where steam is required but not in large quantity, and perhaps only at intervals. With the larger gas-fired boilers, of course, coke and coke breeze come into competition; but we prefer to look at these larger types from another point of view. The report of the Board of Fuel Research, which resulted in the passing of the Gas Regulation Act, pictured gas-works becoming the fuel-supply centres in all districts, and in indus-

trial areas supplying a low-grade calorific gas suitable for steam-raising and other manufacturing heating purposes. The gas-fired boiler offers its aid in the realization of that ideal, and so assists to bring it within the range of practical politics.

In the second part of the lecture, Major Gregson discussed the theoretical considerations attaching to the problems associated with the development of the waste-heat boiler. Accepting the statements of the author, these problems have been mastered and met in the design and methods of operation of the Spencer-Bonecourt "Kirke" waste-heat boiler. This section of the lecture is as highly informative as the first part; and it will, if for this reason alone, well repay the perusal of those who are considering the utilization of some of the thermal energy that is now running to waste from retort-benches and water-gas plants.

Our Fuel Waste as Seen from Abroad.

A COMPETENT investigator and critic of our uses of fuel, and of current research in this country into the production of greater economy and efficiency, is M. Etienne Audibert, Chief of the Research Station of the Central Coal Committee of France. In later columns, we review a brochure which he has prepared on the subject of his personal inquiries. His report is incisively worded; and we are glad that it is so, for there is nothing more stimulating than to be told the truth upon a matter of such national importance. And the truth is courteously told by M. Audibert. To put the position briefly, he finds much research work proceeding; but, with only one or two exceptions, he cannot discover that the results of it all are finding expression by developments in practice. We may claim that one of the exceptions is the gas industry. There is no room for doubt that he is deeply shocked by our prodigality, both in the winning of coal and in its use. We accept the censure with all humility—for in part it is true. Much second-rate coal is left underground because of the restricted market for it, owing to the want of application in practice of methods that would enable its efficient utilization, and would thus provide the demand for it. Another thing that surprises him is that from 35 to 40 million tons of screened coal are annually used in open grates. The gas industry is doing its best to bring about a change in this direction. Admittedly, it is a gigantic work to effect the change; and what has so far been accomplished in this direction—proud as the gas industry is of it—is dwarfed when we place in comparison the results of our efforts with that enormous aggregate of coal which is used every year in our domestic grates. M. Audibert recognizes the new life that was put during the war into this matter of research into fuel economy and more efficient utilization; but in almost every direction, he looks in vain for the material practical achievement in the elimination of waste. The domestic coal fire, our investigators have proved, at the best only gives us 20 to 24 p.ct. efficiency; the average efficiency of our steam-raising plants is only some 60 p.ct. Research tells us what to do; but established practice continues largely and obstinately to prevail. There is a ray of sunshine in the criticism. Fervent is M. Audibert's praise of the work of the Gas Investigation Committee of the Institution of Gas Engineers and the Leeds University, as carried on by Prof. J. W. Cobb and his staff of assistants. Coming from a disinterested and competent foreign authority on these matters, the fact that the research work that the Institution has done so much to support is singled out for special mention and praise, on the ground of its scientific and practical value, will be highly gratifying to the Council and the members generally. But for the rest, it must be acknowledged that the strictures are justified. Having said this, we should like to suggest to M. Audibert that he should now tell us what France is doing in those matters in which he finds we fall so far short, and whether that country can claim in all directions higher utilization efficiencies than obtain here.

Prescription and Inspection of Gas-Piping, &c.

It is useful sometimes to ascertain what other people think on a subject in which one is intimately concerned. The "Star" has been examining, and has published its views on, the two proposals that the gas undertakings should be given powers to prescribe the size and material of internal gas-pipes, and that they should be authorized to inspect house gas piping and consuming appliances, and if, in their view, they regard them as dangerous, to cut-off the supply of gas. These suggestions appeal to us as being perfectly rational; but our evening contemporary has been scrutinizing them through the wrong end of a telescope, and with a very narrow mind. It seems to find it impossible to appreciate that it is not to the interest of a gas undertaking to lose a customer if it can be avoided; that it is to the interest of gas undertakings to do what they can to ensure the highest economy combined with efficiency in the use of their prime commodity; and that it is to their interest, as well as that of the public, to condemn dangerous gas-fittings. The men at the top of gas undertakings are manifestly regarded as—not honest business men, but as sharpers. The "Star" objects to the proposals, because gas undertakings, as vendors of gas-piping and stoves, are not sufficiently impartial to be trusted with the uncontrolled power to prescribe the size and materials of pipes and stoves. They will be able to bring pressure to bear on the occupier to take out his old burners and pipes, and use those recommended by them. Sometimes a gas company wants to push a special burner because it has been invented by one of its officials; sometimes it adopts a special type of stove one of the merits of which is the quantity of gas it burns! The best comment to make on all this is the laconic one—Rubbish! The "Star" says the suggestions will not help in such a case as the Bethnal Green one. This comes into the category of preventive measures in which closer co-operation is sought between road authorities and gas suppliers. The Bethnal Green accident would never have happened if there had not been road subsidence and the main (which had, in its normal situation, stood the test of time) had not been brought down so that it rested on a brick, which, with heavy traffic, caused an unequal strain upon the pipe. When one considers the 40,000 miles of mains of statutory gas undertakings (excluding those of non-statutory concerns and all service-pipes), such accidents are surprisingly few.

Big German Gas Scheme.

Some of the industrial magnates of Germany do things in a colossal way. One of them, Herr Thyssen, has planned a big scheme for gas supply along the banks of the Rhine. According to the "Iron and Coal Trades Review," he has taken a 99 years' lease of the Bonn Gas-Works, and is negotiating with the Municipality to supply Königswinter, Godesberg, Beuel, Honnef, and other towns on the opposite bank of the Rhine. He is desirous of acquiring all gas undertakings from Cologne to Mayence, and monopolizing the entire supply over an enormous area on similar lines to those in the Elberfeld-Barmen district. The scheme contemplates the acquisition of land on the banks of the Rhine for the erection of gigantic gas-works, with water facilities for the transport of coal and the export of coke and other secondary products. Apparently Germany believes in concentrated gas production, and long-distance transmission of gas.

Cost of Oil Exploration.

A question was asked in the House of Commons recently as to the cost of the oil exploration that has been carried out on behalf of the State. The information was given that, after allowing for the amounts realized by the sales of oil, plant, and machinery, the outlay was approximately £564,000. At only two of the eleven borings was oil found in appreciable quantities. Both these wells have been disposed of; and so far as the Government are concerned, the operations are at an end. There has been no pecuniary advantage to the State beyond the information gained—only loss up to date; and what has been done, it is confessed, was the best way of preventing further loss. This shows that, so far as home oil production is concerned, the country will have to rely on coal carbonization and shale distillation.

Exports of Gas and Other Coal.

The quantity of coal exported in March amounted to 7,180,102 tons, compared with 5,201,235 tons in March, 1922, and 1,968,078 tons in March, 1921. The value of the amount shipped last month was £8,817,851, or an average of £1 4s. 6·7d. per ton. Of the total 866,607 tons were classified as gas coal, having a value of £1,039,027, or an average of £1 3s. 11·7d. per ton. For the first quarter of the year, the total quantity of coal exported was 18,694,402 tons, of a value of £21,961,486. The gas coal exported in the three months amounted to 2,290,790 tons, with a value attached of £2,633,859.

Chemical Topics.

A new feature in the "JOURNAL" is to be "Chemical Topics from Current Literature." The contribution will appear monthly; and it will be prepared with the view of being of special interest and value to chemists associated with the gas and other coal carbonizing industries. The first instalment appears to-day.

Gas Coke Shipments.

The first three months of the year showed a good ascent in the amount of gas coke exported. In March, 1921, it was 68,230 tons; in March, 1922, 75,791 tons; in March this year, 93,865 tons. In March, 1921, the 68,230 tons had a value of £153,515; while the 93,865 tons of last March had a value of £144,777, or an average of £1 10s. 10d. per ton. The gas coke shipped during the first three months of this year amounted to 294,553 tons, with a value attached of £428,941.

Sulphate of Ammonia Exports.

The shipments of sulphate of ammonia in March amounted to 18,343 tons, compared with 12,868 tons in March, 1922. During the first three months of this year, 64,338 tons were exported, or 22,865 tons more than in the first quarter of 1922. This is good business.

Railway Rates for Coal.

The disappointment appears to be general that the rates for the railway carriage of coal have not been reduced. The Railway Managers doubt whether coal consumers would benefit by any saving in the lowering of the railway rates. We are of opinion that gas consumers would. It is alleged that the reductions in the railway rates last year have not resulted in any lowering of prices to coal consumers. This is a rather difficult thing for the Mining Association to contest in respect of domestic consumers; but as to industrial consumers, the lightening of conveyance rates so far as it went was of value. At all events it helped gas undertakings to reduce their prices. The pithead prices have little to do with the railway charges for carrying coal; but the Mining Association say that at the beginning of last year, the average pithead price of large and small coal was declared by the joint accountants representing the National Board to be about 21s. per ton. There was a decline by May and June to approximately 18s.; and the price remained near this figure for the rest of the year. Since the removal of control and the restoration of private management, wages in the coal industry have been relatively low, and profits have almost reached vanishing point. "Throughout the period of depression, the coalowners have resolutely set their faces against any artificial means of improving the position of the industry by raising prices. From the very first, they have adopted the policy that only by temporary self-denial in each industry can the ultimate advantage and recovery of the whole country be secured."

Miners and the Price of Coal.

Further on this point, the Association state that again and again the Miners' Federation have urged the owners to raise prices to the consumer in order to bring wages to a level commensurate with the increased cost of living. Recently, 3s. 4d. per ton has been accepted on both sides as the measure of increase in the price of coal necessary to provide a wage for the men equivalent to the general increase of prices. To all such appeals the coalowners have replied that the adoption of a policy of high prices would be disastrous, and that temporary sacrifices, both in wages and profits (and of profits far more than of wages), must be borne if ever prosperity is to return. The statement has been made that the price of household coal has recently increased by 5s. a ton. That is news to the coalowners. They have not raised it. "If prices are tending to rise, it is due to the inevitable pressure of increasing demand on a market that is short of supplies, owing to the curtailment of working hours and the congestion of transport facilities at the ports, of which the railways are so largely the monopolists." It is clear the Mining Association are not persuaded that the railway companies are doing a good part in distributing coal about the country at reasonable rates in order to aid the revival of industry and trade.

The First Twenty Miles.

A proposal of the railway companies has been under discussion before the Railway Rates Tribunal, that the first twenty miles of conveyance should be divided into two gradations of ten miles each for coal, coke, and patent fuel. For the railway companies, Mr. J. Pike contended that the adoption of two ten-mile gradations would cause less disturbance of existing rates, whereas one twenty-mile gradation must result in a scale that would be far too high for distances between ten and fifty miles. For the Mining Association, Mr. Jacques Abady opposed the proposal, pointing out that the charge for the first ten miles would be more than the charge per mile for the second ten miles. This would put a greater burden on short distance traffic. The Mining Association prefer the retention of the existing mileage gradations, starting with the twenty-mile one. Several other organizations and coke producers also opposed; but the Tribunal unanimously agreed that the mileage gradation for coal, coke, and patent fuel should be as proposed by the railway companies.

PERSONAL.

The vacant position of Engineer and Manager of the Brighouse Corporation Gas-Works, caused by the appointment of Mr. C. W. WARD to Wakefield, has been filled by the promotion of Mr. Ward's assistant, Mr. C. R. INGHAM, who has been Assistant Engineer and Manager at Brighouse for two years. Before going there, he for some time occupied a similar position at Ossett, where he served his articles under Mr. A. E. Mottram, Engineer and Manager of the Ossett Corporation Gas Department. He served four years in the infantry during the war.

We sincerely regret to learn that Mr. H. JAMES YATES is confined to his home through indisposition. As soon as his medical adviser will allow him to do so, he is to take a sea trip.

The many friends of Mr. E. HAZZARD HARMAN will be pleased to know that he has commenced on the "advisory and sales" side of retort settings, producers, recuperators, and refractory materials. He will act in this capacity for Messrs. Stein and Atkinson, of No. 47, Victoria Street, Westminster, the well known engineers. In addition, he will represent Messrs. Stephens, the makers of "Dinas" silica bricks, Kidwelly. With Mr. Harman's excellent training and experience, both in theory and practice, of this important branch of work, his endeavours should merit every success.

OBITUARY.

The death has occurred in his 75th year of Mr. DAVID CREIGHTON, who not long ago retired from the post of Collector and Cashier of the Belfast Corporation Gas Department, in whose service he had been for over forty years. Mr. Creighton was held in the highest esteem by members of the Gas Committee and the officers and staff of the department, and was the recipient of several valuable gifts on his retirement.

We regret to announce the death of Mr. WILLIAM TROTTER ROBERTSON, which took place on Monday, in London, in his 71st year. He had been connected with the Aldershot Gas, Water, and District Lighting Company as a Director since October, 1893, and was Chairman from 1912 to 1919. Mr. Robertson was also a prominent local public man. He was a former Chairman of the Urban District Council, a County Councillor, Chairman of the local Bench of Magistrates, Chairman of the Aldershot County School Governors, and Founder and Chairman of the Aldershot Cottage Hospital.

Mechanical Methods for the Propulsion of Gases.

There has been published in the "Journal of the Society of Chemical Industry," the text of a paper by Messrs. E. F. Hooper and B. B. Waller, in which details are given of the design of gas exhausters and compressors. Referring to the four-blade type of compressor, it is remarked that a great advantage which this has over the two-blade form is the increased capacity which it affords. In the case of two machines illustrated, the four-blade compressor will pass 30 p.ct. more gas than the two-blade, so that to perform the same duty the latter would have to be made 30 p.ct. larger than the four-blade, or else run at a 30 p.ct. higher speed, with proportionate wear and tear. Diagrams indicate the comparative amount of power required by the two types of machines when compressing and discharging equal volumes of free gas against a pressure of 5 lbs. per sq. in.; the saving in the case of the four-blade type amounting to approximately 10 p ct. A further advantage which this machine has over the ordinary type is that slipping of the gas past the blades is materially decreased, owing to the slip having to take place past two blades, instead of one, during a considerable portion of each discharge period. As slip is much greater at high than at low pressures, this gives a distinct gain in volumetric efficiency.

ELECTRICITY SUPPLY MEMORANDA.

The Electricity Commissioners and Coke.

The fact that coke should be mentioned by the Electricity Commissioners in their report on fuel practice and thermal efficiencies at electric power stations (previously referred to in the "Memoranda") as one of the staple fuels now in regular use, is in itself significant and indicative of progress and enlightenment. But exception must be recorded to a footnote in the report to the effect that "where returns have not specified the calorific value, the following calorific values have been taken for calculating the thermal efficiency—viz., coal 10,500, *coke* 6000, and oil 18,000 B.Th.U. per lb." Now, it is within knowledge that coke is used at many important power stations which come within the purview of the Electricity Commissioners, as well as many lesser private plants which, to the owners, are no less important in the matter of fuel costs per unit generated. In the aggregate, the quantity of coke returnable as used at the larger power stations alone would probably be about 150,000 tons for the year under review. Having regard to the long experience of power-station engineers in fuel purchase, it may safely be accepted that coke is used simply because it pays to do so; but coke of a calorific power of 6000 B.Th.U. is poor stuff, and is not likely to find a market as fuel among such hypercritical buyers. For the information of prospective users, it may again be pointed out that coke contains mainly carbon, and, of course, the inert matter resident in the coal from which it is made. The calorific power of carbon is well established, and in textbooks is given as 14,500 B.Th.U. per lb.; so that the assumption of a calorific value of only 6000 B.Th.U. would make allowance for no less than 63 p.ct. of ash and incombustible matter. Apart from the fact that such stuff would not be saleable, except perhaps as building material, the assumption of such a low calorific power tends materially to show the thermal efficiency of power stations using coke in what might be described as an "artificial light." It is only necessary to state the calorific power of the fuel used at a low value in order to raise the apparent ultimate efficiency of the power station; and in the case of those stations where coke represents over 50 p.ct. of the total fuel consumption (as in several cases it actually does), this factor becomes important.

Efficiency and Other Points.

The introduction of coke as fuel at power stations, which now appears to be established on a permanent basis, has been less a matter of supplies and prices than one of ways and means of using it on existing chain-grates. The patent "Sandwich" system, now in use with coke as fuel at the power stations boasting the lowest fuel costs in the country, has not only rendered available an additional fuel, but has paved the way to improved efficiency and important economies in fuel costs and raw material; and the London Coke Committee, through whose organization the introduction of coke has been achieved, should feel gratified by the official recognition coke has now received at the hands of the Commissioners, though the official estimate of its calorific power needs revision. Meanwhile, it should be sufficient for electricians to note that the net evaporative value of coke is of the order of 10 lbs.; hence its calorific power, if the combined efficiency of the boiler, stoker, and fuel is assumed to be only 75 p.ct., is not 6000, but 13,000 B.Th.U. per lb. Coke breeze, now also in use at progressive power stations by means of the "Sandwich" system, might be described as the equivalent of coal slack in grade. It has a lower calorific power if supplied unwashed, and would probably average over 10,800 B.Th.U. (or 6000 calories) per lb. It is extremely popular among those who have discovered its advantages, as it facilitates the use of inferior coal slack which hitherto was considered impossible, however cheap or plentiful. Its economic value is not therefore to be confused with mere considerations of calorific power. In future returns, it would be interesting to note the various estimates of the calorific power of both coal and coke by those who are anxious to show not only a reasonably high thermal efficiency, but also, and at the same time, a low fuel consumption in pounds per unit generated. Perhaps the Commissioners may see their way in future to give not only this information, but also the names and locations of the power stations. Such information would certainly be an acceptable contribution towards the gaiety of nations.

Organization and Interdependence.

Probably there is no public utility industry that, on the one hand, internally criticizes itself more than the electrical industry, and, on the other hand, boasts of what it can do, but fails in the performance. One goes to a meeting, and hears of the golden future, and leaves it with eloquent words ringing in the ears as to the industry having stepped on to the high road leading to this good fortune. One goes to another meeting, and hears that, while things continue as they are, progress cannot be made. Here it is learned that it is co-operation which is wanted—a recognition that every part of the industry is indispensable to the other parts, and that they should work together to the one end. This is a condition which is the correct one; but its existence is denied; and, in fact, is not discernible. Between these two contrary views, it must be difficult for the uninformed onlooker to satisfy himself as to the actual position of the industry. He will rightly measure the position, if he takes the critics as being fairly correct, and adds to the strictures the fact that in the lines along which progress is desired—cooking, heating, and hot-water provision—there are inherent difficulties in what they have to offer which obstruct the attainment of popularity. At the recent annual dinner of the Electrical Contractors' Association, the President (Mr. Howard Marryat) alleged that what was fundamentally wrong was the lack of organization of the industry as a whole. We are not so sure that he is altogether on good ground here. There is plenty of organization, and to spare, in the electrical industry. What no doubt he has in mind is the bringing of the various sections of the industry together in one united organization. Perhaps that would be less necessary if there were general recognition of the interdependence of all the different parts of the industry. It may be that recognition will never grow until, or unless, there is an assembling of the parts into one body; but this course would be unnecessary if there were full recognition of interdependence, and the existing organizations entered into closer co-operation. This is being done to some fairly considerable extent in the gas industry; but we frankly admit that there is room for its development. As, however, progress is made, we believe that not only will the inter-relationship of all parts, and the indispensability of every part, be more and more accepted, but actual co-operation will spread and deepen. Mr. Marryat gave an illustration of the absence of the spirit of co-operation; and one can detect in his remarks the opinion that among electrical engineers the commercial instinct is of a low order. He pointed out that in many places large sums of money are being spent in extending cables; but, though this is being done, the engineers will make no concession to the contractors, but charge them the maximum prices for energy used to demonstrate the virtues of electrical appliances, the use of which would result in increasing consumption. There is not much encouragement in this policy.

Registration and Wiring.

At the dinner, there was allusion to two other matters of interest. They were separate, and yet in a way they had relationship. The lead was given to reference to them by Mr. C. H. Wordingham. He was proposing a toast, and mentioned that the Association had not used their power for forcing-up prices; but for improving the standard of work done by their members. The electrical contracting business has had its doors wide open; and everybody who so willed stepped inside. The result has been deplorable, judging from the widespread complaints that have been made as to the character of the work—dangerous and inadequate in design and execution—which has been done by these men. They have had no idea of high standard work. If they have, they have worked at cut prices in order to obtain jobs; but what they have given for these prices has been of a nature that has been dear to the user, in view of poor quality and inadequacy. As we say, there have been widespread complaints, Electricity supply officials have recognized the existence of the evil; and the contractors of good standing have considered the matter. They have a personal interest—not only monetary, for scamped and poor work touches their own reputation. The problem of how to deal with this has been one for serious consideration; but no scheme has been found better than that of voluntary registration. This has been warmly supported by the Association; but we cannot see that it will have much (if any) good result unless strongly aided by the electricity undertakings, and propaganda work be undertaken among the public with a view to induce them only to employ those contractors who are registered. There can in this matter be no compulsion on the public. It must be a matter of gentle persuasion and education. A cognate matter is that of the wiring rules of the Institution of Electrical Engineers. There has of late been a revival of discussion over these. There is talk of grading them from high standard work to a lower standard for different classes of houses. Some people, too—for example, some of the municipal people—would like to see the rules made compulsory; others—the companies—would prefer that there were no rules; while others again would like to see them even more detailed. But it is asserted that no other industry tries to regulate its operations by one set of regulations. The best that Mr. Wordingham could say for the rules was that in them they tried to teach the wiring men the way to carry-out their work; and those responsible for framing and (as required) amendment had endeavoured to make them applicable to all sorts of jobs—an almost impossible task. Of course, there is no power to enforce the rules—other than by electricity authorities refusing to supply premises the wiring of which does not come up to their requirements in respect of safety, and the Fire Offices need not insure premises on which the electrical installation does not meet with their approval. But it would not do for the Institution wiring rules to be withdrawn. What would happen? Supply authorities and the Fire Offices would return to the making of their own rules, and in this respect there would be chaos again. Every contractor would then have to see which Fire Office was going to have the insurance business, and then the electrical installation would have to comply with the rules of both that office and those of the supply authority, in order to ensure supply being given and the issue of a fire insurance policy. However, it is not likely that the rules will be withdrawn. They will probably be much modified to represent different grades of work, as, so expediency says, a different grade of work will suit the poorer and middle-class properties than would be appropriate for,

or be tolerated in, the better-class properties. At the same time, there is a feeling among the contractors that if registered contractors become a sufficiently strong body, this will ensure good work, and then the rules can be thrown overboard, or burned in an electrically produced conflagration.

Electrical Regulations in South Africa.

By the way, it seems that in South Africa, they are very particular regarding the carrying out of installations in accordance with municipal regulations. The South African correspondent of the "Electrical Review" reports that, at the Cape Town Criminal Court recently, a man named Frank Scullard was charged with contravening the municipal regulations for the licensing of electricians by executing wiring work at premises connected with the municipal power station, without being in possession of the necessary licence. An installation inspector stated that the work was not done in accordance with the regulations, and, in one instance, two flexibles were taken from one ceiling-rose. Accused, who admitted a previous conviction under the Electric Lighting Act, in 1921, was fined £2.

The "Review" Makes an Inconclusive Reply.

In the "Memoranda" last week, comment was made upon an editorial which had appeared in the "Electrical Review" on the subject of "Helping Smoke Prevention." Mr. W. Baxter, who is a member of the Electrical Committee of Leith, has written a letter to our contemporary in which he says its article leaves in obscurity many facts that would answer the question, "Why electrical men do not use electricity in their own homes?" He makes comparisons on a sound basis between gas and electricity in respect of costs for cooking and heating—showing among other things that it takes 29 units of electricity to provide the same heat as 1 therm supplied by gas. His final thrust is that "until electricity can be produced without wasting, under present best working conditions, fully 80 p.ct. of the thermal value of the coal consumed, even electrical men will not use it for cooking and heating." Our contemporary appends to the letter a vague note, in the course of which it says: "We deny that the cost of electricity for cooking at 1½d. per KW.-hour is prohibitive—or even at 2½d. For continuous heating, we admit that electricity is too costly at present; but the same is true of gas. For occasional heating, electricity is thoroughly satisfactory and not unduly expensive. Our correspondent quotes again the fallacious comparison of thermal units supplied, ignoring the fact that with electricity they are almost wholly available, whereas with gas only a portion can be utilized. He can buy 100,000 B.Th.U. of coal, so to speak, for 2d.—but how much of that can he use? According to his mode of argument he ought to stick to coal!" We ask the "Review" to deal a little more fully with the latter statement, as applying (let us say) to heating, and to the work done on the hotplate of a cooker. Heating and cooking would be, assuming adoption, the two most extensive uses of electricity in domestic service. Independent scientific men have shown that in room heating, 75 p.ct. of the heat generated by the combustion of gas is given off as useful heat by the gas fire. The 75 p.ct. of a therm would be 75,000 B.Th.U. Let us assume that the therm is purchasable at 9d., and that electricity costs 1d. per unit, nine units of electricity would only develop 30,780 B.Th.U. And does the "Review" really think that the conversion of electrical units into heat by means of electric fires can be accomplished always, or ever, at 100 p.ct. efficiency? If so, why is it that electric fires vary so much in results in radiant heat tests? Gas fires of different types and make vary in just the same way; but, generally speaking, the efficiency of fires now on the market, manufactured by the recognized makers, approximates 75 p.ct. Take, again, the efficiency of the hotplate, would our contemporary rather have 50 p.ct. of 100,000 B.Th.U., or 50 p.ct. of 30,780 B.Th.U.?—the potential energy supplied for 9d. at 1d. per unit. And 50 p.ct. is not the highest efficiency that can be obtained on the hotplate of a gas-cooker to-day! Our contemporary might apply itself to a consideration of these figures, and let us know, through its pages, what it has to say in the way of criticism. So far it has not said enough in reply to Mr. Baxter.

Association of Statutory Inspectors of Gas-Meters.—The annual general meeting of the Association of Statutory Inspectors of Gas-Meters will be held in the New County Hall, Westminster, at 10.30 a.m. on Wednesday, the 30th inst. A conference with representatives of administering authorities will take place at 2.30 p.m., when a discussion upon the "Stamping and Sealing of Gas-Meters" will be opened by Mr. Jas. Ollis, Chief Officer, Public Control Department, London County Council.

Southern Association Visit to Plymouth.—Members of the Southern Association of Gas Engineers and Managers are asked by the Hon. Secretary (Mr. W. H. Bennett) to note that the invitation extended to them by the Chairman and Directors of the Plymouth and Stonehouse Gas Company to visit the President's works and to a trip upon the River Dart on Friday, May 25, has been altered to Friday, June 8. It has been ascertained that, owing to the meeting of another organization in Plymouth, insufficient hotel accommodation would be available on the date originally fixed. A joint meeting of the Districts will be held the previous day at Plymouth. Full particulars of the visit (with list of hotels and trains) will be posted to members later.

CHEMICAL TOPICS FROM CURRENT LITERATURE.

A Monthly Synopsis of Recent Technical Publications.

By H. J. HAILSTONE, F.C.S. (Rochdale).

VOLATILE MATTER DETERMINATION.

Many methods have been more or less standardized for the determination of volatile matter in coal; and a comparison of some of these methods has been made by H. Steinkamp (Brennstoff Chemie), who finds that the American method of heating for seven minutes in a platinum crucible gives higher results than those obtained by the "Muck" method, which employs one gramme heated in a crucible until the luminous flame disappears. In laboratory determinations of this type, the results obtained are affected by many factors—viz., the weight of the sample taken, the fineness of division, the size and shape of the crucible and metal of which it is composed, the type of burner and flame, and the period of heating. In estimating the percentage yield of coke from pitch, the influence of all these factors is particularly marked, and should be understood before deciding on the best method to use in control work. It is clearly of great importance to employ exactly the same procedure in every case when making comparative tests of coals and pitches.

COKE TESTING.

Few methods have been devised whereby differences in the comparative burning power of cokes may be determined on a small laboratory scale. For blast-furnace and foundry work, and for water-gas production also, the coke should burn readily. F. Fischer and others (Brennstoff-Chemie) have dealt with a very interesting method for determining the ease of combustibility, which method consists of gradually heating a quantity of the finely-divided coke in a slow current of carbon dioxide. The exit gases are passed into a 50 p.ct. solution of potash, and are completely absorbed so long as none of the carbon dioxide is reduced to carbon monoxide. The temperature at which unabsorbable gas is first formed affords a means of comparing different cokes; and the following results have been obtained by the method: Charcoal, 650° C.; semi-coke, 700° C.; foundry coke, 800° C. It has been noted that an easily burning coke has been adversely affected in this respect by mixing with tar and reheating to 1100° C.; and it is thus made clear that the property is dependent upon the surface development and structure of the coke. This gives another instance of the importance of a sound knowledge of physical structure and surface conditions and the part they play in accelerating or retarding chemical reactions. The bearing of the different methods and conditions of coal carbonization processes upon this property of the resulting coke is discussed in the paper.

THE SULPHUR CONTENT OF COKE.

The various forms in which this troublesome impurity exists in coke are enumerated in a paper by A. R. Powell (Journal American Chemical Society), who states that it is found to exist in solid solution in the carbon, as adsorbed sulphur, and as ferrous and other mineral sulphides. Prolonged heating causes the adsorbed element to pass into solid solution. On cooling the coke in the presence of air, the ferrous sulphide is oxidized to ferric oxide and free sulphur, though if quickly cooled, as by quenching, the oxidation may not be quite complete.

HYDROGEN FROM COAL GAS.

The industrial use of hydrogen is a growing one; and a means for the separation of the pure gas from coke-oven gas is described by G. Claude (Comptes Rendus). The benzole is first removed by scrubbing with wash-oil, and carbon dioxide is eliminated by treatment with lime water, after which the gas is partially liquefied to remove the various condensable constituents. The resulting hydrogen may be employed for removing oxygen from air by a combustion process, in order to obtain a supply of nitrogen. This latter is mixed with a further quantity of hydrogen, and is passed, under great pressure, to a catalyzer, for the formation of synthetic ammonia.

ESTIMATING NAPHTHALENE.

Electrometric methods are gradually finding favour in works analytical practice; and such a method is the subject of the United States patent No. 1,413,330 for the determination of naphthalene in coal gas. The operation consists of measuring the electrical resistance of a standard picric acid solution after passing through it a measured volume of the gas. From the degree of increased electrical resistance, due to the combination of naphthalene with picric acid and the removal of the insoluble product from the solution, the amount of naphthalene present in the gas can be calculated.

BENZOLE RECOVERY AND PURIFICATION.

The similarity in the action of the scrubber in extracting benzole from gas, and that of the fractionating column in distillation operations, has been pointed out by Messrs. Brittain and Elliott in a recent paper read before the Liverpool Section of the Society of Chemical Industry. In the process of benzole washing and benzole fractionation, the most volatile products leave the apparatus in the vapour phase; while the less volatile are retained in the washing (or condensed) liquids. Methods of debenzolizing oils are dealt with, and the relative merits of intermittent and of continuous distillation systems for refining benzole are discussed. Among the advantages claimed for continuous processes are

those of greater uniformity of the products, of waste heat recovery, and of economy in labour. Against these advantages are set the factors of higher capital outlay, mechanical and constructional complications, need for more careful control, sensitivity to variations in the quality of the raw material, and the reduced adaptability for dealing with products other than those for which the plant was originally designed. In discussing the functions of fractionating columns, the importance of ensuring an intimate contact between the vapours and the refluxed liquids is emphasized; and the construction of various types designed to obtain this desired condition is described. The advantage of the bell type of tray over the old perforated type is maintained.

Laboratory Distillations.

An account of a new type of laboratory fractionation apparatus for the separation of miscible liquids has appeared in Comptes Rendus. Messrs. E. & R. Urbain describe an apparatus in which the mixed vapours ascend from the distillation flask through a porous porcelain tube, the top of which is connected to a condenser. The tube is enclosed within an outer glass tube which may be put under reduced pressure. In operation, the vapours of lowest molecular weight tend to diffuse through the walls of the porous tube and are removed by the suction effect; while the remaining vapours travel right up the porcelain tube to the condenser, and, if desired, may be returned to the distillation flask for further distillation. Very efficient separation is claimed for mixtures of alcohol and water and nitric acid and water; and it would be of interest to know to what degree the method could be used in fractionating benzoles and naphthas.

Road-Tar Tests.

Particulars of a number of tests for road-tar examination, together with details of the apparatus used, are given in a special catalogue recently issued by Messrs. Baird and Tatlock. Methods are fully described for the determination of specific gravity, specific viscosity, float test, penetration test, melting-point, flash and burning points, volatilization, &c. Attention is also given to dehydration and distillation operations, together with the determination of tar acids and solubility in various solvents. The catalogue forms a useful reference for tar-testing methods.

Sulphates of Ammonia.

Ammonia and sulphuric acid will combine to form quite a number of stable crystalline salts other than the ordinary gas-works product; and particulars of some of these compounds, together with their methods of preparation, have been given by H. Dunnicliff in a research published in the Transactions of the Chemical Society on the action of alcohol on sulphate of ammonia. The compound triammonium hydrogen disulphate $(NH_4)_3H(SO_4)_2$ is obtained by the action of 5 to 7 parts of dry alcohol on one part of dry ammonium hydrogen sulphate $(NH_4)HSO_4$, followed by subsequent treatment with ether to yield a pure product.

The Bunsen-Burner Flame.

The troublesome phenomenon of the roaring of the bunsen-burner flame has received the attention of of K. Glaser, who writes in the "Zeitschrift für angewandte Chemie" drawing attention to the fact that the flame may be caused to roar by increasing the gas-supply pressure, thus creating a greater velocity of flow. Other factors influencing the phenomenon are specific gravity, the rate of propagation of flame for the particular mixture in use, and the amount of preliminary heating of the gas in travelling up through the burner tube. By means of formulæ given, the relation of these various factors is clearly shown.

The Testing of Paints.

This subject has received considerable attention of late; and a paper contributed by H. Wolf to "Farben-Zeitung" gives some important particulars concerning the examination of paints with regard to their weather-resisting qualities. The effects during summer conditions are often quite different from those experienced during winter periods; and comparative tests made on a number of paints in summer may be quite different if repeated in wintry conditions. The influences of light and temperature are by no means as detrimental as those of fog, mist, and frost; a frost following a penetrating mist being particularly severe in its effect on the paint surface. In this connection, the description of a testing apparatus is given, in which temperature and moisture conditions may be separately controlled, and which enables the weather-resisting properties of any series of paints to be ascertained.

The Slaking of Lime.

Manufacturers of sulphate of ammonia will have experienced the difficulties which sometimes arise in properly slaking the lime and making a good cream. These are caused by impurity, by "overburning," and sometimes by too low an initial slaking temperature. A small booklet issued by The Callow Rock Lime Company helps to clear up quite a number of points in connection with the behaviour of lime during slaking, and reproduces a number of "rate of hydration curves" which repay study—particularly as the efficient use of lime in the sulphate plant depends upon proper slaking. In this connection the use of hot spent liquor should by now be universal.

Industrial Lighting and the Prevention of Accidents.—This is to form the subject of a paper to be read by Mr. Leon Gaster before the Royal Society of Arts on Wednesday evening, May 16, at 8 o'clock. It will be illustrated by lantern slides.

THE NATIONAL GAS COUNCIL OF GREAT BRITAIN AND IRELAND.

Annual Meetings of the District Executive Boards.

District.	Date.	Place of Meeting.
Ireland ...	Tuesday, May 1	Dublin
Yorkshire (West Riding) ...	Thursday, May 3	Bradford
Southern ...	Thursday, May 3	Grosvenor Gardens, London
South Wales	Friday, May 11	Cardiff
Manchester	Monday, May 14	Manchester
Eastern ...	Wednesday, May 16	Grosvenor Gardens London
South-Western ...	Wednesday, May 16	Exeter
Midland ...	Thursday, May 17	Birmingham
Scotland ...	Tuesday, May 29 (tentatively)	Glasgow
Northern ...	Wednesday, May 30	Newcastle
London ...	Not yet decided	...

A REVISED EDITION OF THE WORK OF DR. LUNGE.

Two volumes of a new edition of Lunge's "Manufacture of Acids and Alkalis" have been forwarded to us by Messrs. Gurney and Jackson, 33, Paternoster Row, London. This work, which has proved of the utmost value to those engaged in the heavy chemical industries, has been completely revised and re-written under the editorship of Dr. A. C. Cumming. Each volume will be on a special subject and dealt with by a separate author. It is hoped that these united efforts will produce a new edition worthy of the great tradition which Dr. Lunge has established. The volumes which we have received are Nos. 1 and 5—"The Raw Materials for the Manufacture of Sulphuric Acid and the Manufacture of Sulphur Dioxide," by Wilfrid Wyld, price 36s. net, and "The Manufacture of Hydrochloric Acid and Saltcake," by Dr. Alexander C. Cumming, price 31s. 6d. net. Reviews of these books will shortly appear in our columns.

FUEL RESEARCH IN GREAT BRITAIN.

A French View of Our Efforts.

To see ourselves as others see us is generally interesting, and very often both instructive and chastening. We have been privileged to see a brochure in French by M. Etienne Audibert, who is a mining engineer and Chief of the Research Station of the Central Coal Committee of France. At their instance he recently visited our country, with the object of reporting on the progress made on this side in the direction of fuel research.

M. Audibert's opening comment sums up much that is contained in his introduction. "Coal is to be found in abundance in Great Britain, and, for this very reason, it has always had a low commercial value. It has always been customary, therefore, to waste it quite thoughtlessly; producers and consumers showing equal negligence in this respect." In general, the author's opinion is that collieries do not aim at extracting every possible ton from their royalties, but at producing as cheaply as possible. This is largely due to the comparatively short leases they hold, which lead them to concentrate on the profits of to-day and leave to-morrow to take care of itself. This gives rise to methods of working which, though they produce cheap coal, leave a great deal in the seams. And the author remarks that, for the English market, very little "second quality" fuel is brought to the surface, and comments on the difficulty there has always been in disposing of Yorkshire and Lancashire slack. He is duly shocked by the prodigality of our population of some 46 millions in consuming, in open grates, an annual tonnage of 35 to 40 millions of screened coal.

M. Audibert credits us with having to some extent come to our senses during the war—largely owing to the necessity of assuring the liquid fuel requirements of our navy; and he mentions the setting-up of the Fuel Research Board in 1917, and also the efforts made in 1920 and 1921 to bring down the cost of coal to the consumer—partially successful, but still leaving it far too high for suffering industry. These efforts on the part of producers were made, he mentions, almost entirely at the expense of colliery development and profits. This leads him on to a consideration of the measures taken to improve the efficiency of consumers' apparatus, and methods of fuel utilization.

From his visit to this country, he did not receive the impression that much of importance has been achieved in this respect. The problem of greatest interest would be that of improving the conditions of the utilization of coal in the raw state, since of the 180 millions of tons consumed in a normal year in the United Kingdom, about two-thirds are used in this way, either for steam-raising or for domestic purposes. "Now," to quote M. Audibert's words, "the opinion prevails that the only improvements to be realized in the conditions of consumption of these 120 million tons of coal burned in open grates, are such as do not

entail any essential alteration of apparatus or of formulæ now actually in use. Such a restriction places a severe limit on the useful effect of any improvements which might be hoped for."

As an illustration of his meaning, he quotes the instance of the domestic coal-fire, and in particular, Mrs. Fishenden's paper on the subject, published under the auspices of the Fuel Research Board. While all the imperfections of this very British institution are freely admitted, there is no incitement in Mrs. Fishenden's work to replace by any other apparatus so obviously defective a method of heating. The same conservatism, he maintains, characterizes the official attitude towards the problem of improving steam production. Sir George Beilby, before the Institution of Civil Engineers in 1921, declared that the average efficiency of such plant throughout the whole country probably does not exceed 60 p.ct.; that an improvement of 10 p.ct. would save seven to eight million tons of coal a year; and that consumers should aim at achieving this by more careful control of their plant. "According to this," comments our critic, "the only advance envisaged is one which will eliminate a small proportion of the actual waste. And the organization which is officially entrusted with improving efficiencies expects the improvement to come from individual initiative."

M. Audibert finds this same spirit of unwillingness to change established practices in our efforts to discover a means of using slack. Mr. Leonard C. Harvey published the results of his inquiries on behalf of the Fuel Research Board into the pulverized-coal systems in use in America; but beyond this he fails to find that anything has been done. Not only are there at present no slack-fed boilers in England, he states, but all efforts so far made have been in the direction of converting slack into larger pieces, capable of resting on the same old fire-bars, or of being used in water-gas generators.

The state of mind revealed by these three examples has, in the writer's opinion, prevented any serious collective effort being made to improve the conditions under which coal is burned in the crude state. He excepts, to some extent, the Lancashire and Cheshire Coal Research Association. Up to the present he can see nothing that they have achieved worth mentioning. He is willing to concede that they have not as yet had much time; but he has little hope of any results of great general interest, unless arrived at by accident, since their task is the investigation of their own particular problems.

"If the determination of the laws of the combustion of coal has apparently not appeared to be a subject worthy of study," M. Audibert is nevertheless unstinting in his praise of the manifold and highly interesting research work on the subject of gasification, carried on for the Institution of Gas Engineers under Prof. J. W. Cobb at Leeds. Of the Fuel Research Board Station at East Greenwich he received the impression that tar is everything, and gas manufacture merely accidental. He is convinced, in fact, that the Board was formed incidentally to study the technical problem of the use of fuel, but above and before all to solve the political problem of providing the British fighting navy with liquid fuel.

He then proceeds to describe, for his French colleagues, the general conditions governing the gas industry on this side, since the passing of the Gas Regulation Act of 1920. He gives general descriptions of what we are doing in the way of research work, all of which is known to our readers from the reports of the Gas Investigation Committee, the Fuel Research Board, and the Technical Press generally. In conclusion, he acknowledges what he realizes must be the incompleteness of his review, owing to the short time which was available to study our work in this country. He sums up his opinions as follows:

"Working on the principle that apparatus in use must not be modified, English research work has systematically left untouched anything which concerns methods of coal combustion, and has been devoted entirely to carbonization, distillation, and gasification on the one hand, and the constitution of coal on the other. On the latter subject, work is still in progress, and results must be awaited. From indications given hitherto there would seem to be little worth noting, unless it be that the influence of fusain on the friability of coal is worth investigation. Gasification forms the subject of research of a very high practical interest on the part of the Institution of Gas Engineers, the conclusions from which cannot fail to be instructive. The efforts of Mr. Maclaurin, too, may open the way to processes of great practical value. Low-temperature carbonization is, perhaps, the predominating problem upon which energy is being spent at the present time in England. However, the technical and scientific aspects are in every case entirely neglected, and it is only regarded from one very particular standpoint, which comes within the realms of matters political. The effect of this has been to limit very considerably the range of results obtained up to the present time. The proposals for using up slack are, in much the same way, prompted by one special aim, which is to profit by the great difference in price between slack and larger coal, by converting the slack into screened sizes. Except for the Sutcliffe and Evans process, which is both original and interesting, no fresh ideas are to be found."

Midland Association of Gas Engineers and Managers.—We are informed by the Hon. Secretary (Mr. T. Thornton) that the spring general meeting of the Association is to be held at Coventry on Thursday, May 31.

SCOTTISH JUNIOR GAS ASSOCIATION.

Joint Visit to Coatbridge.

On Saturday afternoon, members of the Scottish Junior Gas Association (Eastern and Western Districts) visited the works of the Coatbridge Gas Company. The party, who included many representative people associated with gas undertakings all over Scotland, numbered upwards of 250, and were received at the works by Mr. A. S. Legat (the Chairman of the Coatbridge Gas Company), Mr. George Braidwood (the Engineer and Manager), and other Directors and officials. Chief interest in the visit centred round the newly-installed Glover-West vertical retorts, which have been introduced at a total cost of £63,000.

The visitors had fully explained to them the method of working the new installation; and thereafter they adjourned to the Town Hall, where, through the kindness of the Chairman and Directors of the Company, they were entertained at luncheon.

The usual Loyal Toasts having been duly acknowledged, the CHAIRMAN (Mr. Legat) proposed "The Scottish Junior Gas Association," coupled with the names of Mr. W. A. Dearden (President of the Eastern District) and Mr. W. J. Lennox (President of the Western District). In the course of his observations, Mr. Legat made reference to the interesting fact that the installation of new retorts had enabled the Company to continue supplying what was, with only one or two exceptions, the cheapest gas in Britain. Messrs. DEARDEN (Dunfermline) and LENNOX (Falkirk) briefly replied. The other toasts were "The Coatbridge Gas Company," proposed by Mr. JOHN CHISHOLM (Airdrie), and replied to by Mr. J. D. MILLER, J.P.; and "The Town of Coatbridge," by Mr. J. W. NAPIER (Alloa), acknowledged by Provost KIRK (Coatbridge). The health of the Chairman was proposed in felicitous terms by Mr. A. C. HOVEY.

Prior to the luncheon, the visitors had the advantage of witnessing a film display showing the manufacture of silica bricks and sections and modern carbonizing methods. In addition, there was a demonstration of the "Elland" patent ball carriages.

The installation of the Glover-West vertical retorts comprises 32 retorts heated in units of four, and arranged in four settings of eight retorts each. Each setting is provided with a step-grate producer and a separate steel brick-lined chimney. The nominal capacity of the plant is 1,250,000 c.ft. of gas per diem.

Coal is brought to the installation in wagons, on a railway laid along the side of the retort-house, which are tipped by hydraulic rams. The coal is discharged into a receiving hopper, and mechanically fed to a West double-roll coal-breaker, which reduces it to a size suitable for carbonization. The broken coal is delivered to the boot of an elevator of the fixed-bucket type. The mechanical feeder is also arranged with bye-pass shoots to deliver small coal direct to the elevator boot. The broken, or small, coal is elevated, and temporarily stored in a hopper of twelve hours' capacity arranged above the retort-house conveyor. The latter is of the gravity-bucket type. It encircles the bench, and is used for distributing the coal in overhead coal bunkers of 48 hours' capacity, or for receiving the coke direct from the retorts, elevating it, and delivering it over screens to coke-storage hoppers arranged over the railway. The whole of the coal and coke to and from all parts of the installation is, thus, mechanically handled.

An electrically-driven lift is provided for giving access to the several platforms with which the installation is liberally equipped. All the power for operating the installation is supplied by two gas-engine-driven dynamos of 30 K.W. capacity, erected in a power-house adjacent to the retort-house. The retort-house is of the usual Glover-West design, consisting of a light steel framework filled in with 4½ in. brick panels; and the roof is covered with slates wired to steel angle purlins. The installation is erected upon concrete foundations of substantial design.

Each retort is a separate and distinct unit as regards control and admission of coal, exit of gas, and extraction of coke. The retorts may be heated in units of two or four as required.

THE LIGHTING OF PRINTING WORKS.

At a Meeting of the Illuminating Engineering Society held last Wednesday week at the Royal Society of Arts, Mr. L. GASTER read a paper which dealt with some of the problems connected with the lighting of printing works.

The author recalled attention to the paper given by Mr. F. W. Goodenough on the subject in 1912, which was published in the "JOURNAL" for Mar. 26 of that year. Since that time, however, many notable developments in illuminants have been made, among which is the introduction of vitreosil globes and cylinders in gas lighting. The keen competition in the printing industry, said Mr. Gaster, is based on service as well as price; and the printer who can render superior service can command a better price. Service in printing involves chiefly accurate, neat, and quick work, each of which requires good illumination. Delay in any of the various stages of composition, make-up, presswork, and binding may make all the difference between profit and loss. It should be borne in mind that the product of both journalists and printers was prepared exclusively for exhibition to the eye. This fact alone made it essential that the work of preparation

should be done in good lighting conditions, enabling the material to be inspected with ease and comfort. By reason of the fact that printers as a whole, and compositors specially, worked continually with the eye and the brain, they were, perhaps, more sensitive to working conditions and appreciative of their improvement. Improved lighting meant not only greater visual comfort, but also a more cheerful workroom.

The Cost Factor.

It has been repeatedly pointed out that the cost of good lighting forms but a small fraction of the total costs of production. In printing offices this is particularly true, for highly skilled labour is employed, costly machinery is used, and over-all charges are uncommonly high. If it is estimated that the cost of artificial lighting amounts to 1s. per man per week, and that the wages he receives are about £4, it is seen that the cost of lighting forms about 1 p.ct. of the wages bill. This is confirmed by the author's experience in cases where the wages bill varied from £20,000 to £500,000 per annum, and the expenditure on lighting from £200 to £5000. In many cases less would be paid, and the fraction would be even smaller. In a large printing works it was found that after the conditions of illumination had been thoroughly modernized, the general efficiency of work was improved by 25 p.ct. Consider, too, the large number of operators engaged in the printing industry, which is estimated to be about 250,000 in the United Kingdom. If by better lighting, one can secure even a small improvement in quality of work and speed of execution, owing to the avoidance of unnecessary delays and mistakes, a large saving might be made on this sum.

The General Methods Employed.

There are three main methods of lighting: (1) Unshaded or imperfectly shaded lamps placed over the centre line, so as to illuminate the racks on either side. (2) Lamps equipped with suitable reflectors used in the same way. (3) General lighting from overhead lamps. The first method cannot be recommended. The exposed filaments are troublesome to the eyes of the workers; and the proportion of light reaching the racks is very low. If, however, the lamps are equipped with suitable reflectors, and their distance apart is well selected, it is possible by method (2) to obtain good illumination. Some compositors prefer local lighting; but it is usually desirable to supplement this mode of lighting by general illumination, in order to throw light on the drawers below the inclined face, to ensure adequate lighting of gangways, and to eliminate undue contrast.

The Lighting of Matrix Boxes.

The lighting of linotype or monotype matrix boxes, where manuscripts are tapped out, is usually effected by adjustable local lights placed about 18 in. above the keys, and screened on the side facing the worker. This is a process which needs strong local lighting, as the operator has not only to see the keys, but has also to distinguish the handwriting of the contributions he is dealing with. Such sources need careful screening. A recent test in a printing works gave 4 to 8 foot-candles on the keyboard, 4 to 8 on the copy, and 4 on the setting drum—the latter being a particularly important spot in view of the small letters and numbers on the drum which have to be distinguished.

Machine Room Lighting.

In machine rooms it is obviously desirable that the surroundings should be light in colour, and the illumination fully diffused, so that all interstices in complicated machinery should be clearly revealed. The point might be raised whether, for the examination of first sheets, general diffused lighting was sufficient; and it might, therefore, be good practice to supplement the general lighting by a local adjustable fitting. The proper illumination of the machinery is not an easy problem. As a matter of principle, lamps should be so situated that a flood of light could be directed on the part inspected, without the operator's eyes being dazzled by glare from exposed filaments. The requirements for ordinary reading and writing were studied by the Joint Committees of the Society concerned with the lighting of schools and libraries prior to the war; and office lighting has recently been the subject of discussion. The general conclusions formed in regard to these fields of lighting apply to newspaper offices; but the requirements are more exacting. A child at school, or a reader in a library, is assumed to deal with clean white paper, and well printed books. But the matter sent in to a newspaper is still largely written by hand. Even matter presented in proof often does not compare favourably with the appearance of the type in the finished production. In etching and lithography the conditions are such that a highly diffused source, with an extensive luminous area, is preferable.

The paper contained a table indicating the order of illumination for various processes, as measured on the actual place of work. The figures included the values given by Mr. Goodenough, and also those determined by the author in 1923. They contrasted with the code of the American Illuminating Engineering Society, whose recommendations were for much greater illumination.

Summary.

The chief points in the paper may be summarized as follows:

(1) Printing is a highly specialized process involving the use of costly machinery. Good lighting is therefore of vital importance; and its cost forms only a small fraction of the total operating expenses.

(2) In rooms containing quick-running rotary presses, &c., there should be general illumination from overhead lights. Facilities for the lighting of parts of machinery without glare should be provided. General illumination on the floor should, in the interests of safety, not be less than 0·5 ft.-candles, irrespective of the working illumination.

(3) The illumination on the benches of compositors, making-up tables, lay-out surfaces, and other places where work is inspected, should not be less than 5 ft.-candles.

(4) In editorial and proof-reading rooms, the working illumination should not be less than 5 ft.-candles.

The Resurrection of a Popular Fallacy.

The paper was illustrated by lantern slides, many of which showed the excellent results obtained by the use of gas as an illuminant. Indeed, the whole of the important points brought forward in the address seemed to indicate that the inherent qualities of gas lighting—its low intrinsic brilliancy, the soft diffused light eliminating the ill-effects of glare, the restful effect on the eye—made this form of illuminant eminently suitable for this particular work. Prejudices still exist, and one is not surprised that the inevitable argument that gas is unhealthy should once more be brought forward in the discussion which followed the paper. Surely it is time that this ill-conceived and foundationless shibboleth was laughed away. Perhaps, however, the advancement of such an argument is a subtle proof of the real absence of vulnerability of gas as a light source, which defies the ingenuity of its opponents. It is, of course, well known that gas can serve as a highly efficient ventilator, thereby promoting, rather than militating against, healthy conditions.

Further Points.

Another point advanced was the influence of the room itself on the general lighting effect. If the walls were such as to absorb as little light as possible—as, for example, in the case of tiled walls—then not only would the whole effect be cleaner and more satisfactory, but in all probability the cost of illumination would be considerably lessened. In this connection, it was remarked that too little attention was paid to daylight illumination, which frequently was inadequate.

The discussion also brought forward a few points concerning the employment of electric light, among which were the unsatisfactoriness of the Cooper-Hewitt lamp, and the consumption of the gasfilled lamp, which was stated to be 1·25 watts per candle power in one case, in addition to the fact that it was positively dangerous to eyesight.

The Views of Printers.

The Rt. Hon. C. W. Bowerman recalled the conditions of light usual in printing works in the past. Methods of illumination in well-lighted works to-day presented a complete contrast. He well remembered a time, in the works where he was employed, where the lamps were so badly placed that the men had to wear shades to protect their eyes. It was of the greatest importance that lights should be properly shaded, as Mr. Gaster recommended. On behalf of the Joint Industrial Council of the Printing and Allied Trades (of which he was a past-president) he welcomed the co-operation of the Society in dealing with this important problem.

Mr. A. E. Goodwin and Mr. A. E. Holmes (Joint Secretaries of the Council) also expressed their interest in the paper, and emphasized the desire both of employers and workers to obtain the best methods of lighting. Mr. George Isaacs (the National Society of Operative Printers and Assistants) expressed similar views, and pointed out the need for learning the views of workers, and finding out the reasons for their preferences for certain forms of lighting. In the lighting of machine rooms, it was necessary to have lamps inside some of the larger machines, and it was difficult to arrange these lights so that they were convenient to men on one side the machine without shining in the eyes of those on the other side. If the Society could devise means of illuminating the inside of the machines indirectly, this would be very useful. Miss Bridge (Chairman of the Health Committee of the Joint Industrial Council) said that her Committee were now devoting special attention to the question of lighting, and would welcome the aid of the Society. Mr. J. R. Riddell (Principal of the London School of Printing) described some of the methods of lighting adopted at the School, which he thought was second to none in this country. He entirely endorsed the view as to the necessity of co-operation between the illuminating engineer and those actually engaged in printing.

A number of members of the Society, including Mr. J. G. Clark, Mr. P. J. Waldram, Mr. G. Campbell, and Mr. F. E. Lamplough, also joined in the discussion. Mr. Clark emphasized the importance of proper shading, and pointed out that in printing works it was particularly important to bear in mind not only the effect of the light on the worker, for whom it was specially intended, but also its influence on adjacent workers. Light colours for walls and ceilings were also important. Mr. Clark also drew attention to the opportunities for gas lighting in the printing business; and remarked that the discussion, on the part of those who used the light and those who provided it, had furnished some useful hints. He believed that this was the best co-operative meeting of the Society which he had ever attended. Mr. F. E. Lamplough showed a new form of lighting unit for furnishing artificial daylight, which should be of use to colour printers.

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.

ANNUAL MEETING AT NEWCASTLE-ON-TYNE.

The Annual General Meeting of the North of England Gas Managers' Association was held last Friday at the offices of the Newcastle-on-Tyne and Gateshead Gas Company, Grainger Street, Newcastle-on-Tyne. Mr. J. E. BLUNDELL, of Carlisle, the President, was in the chair.

THE INSTITUTION MEETING.

The PRESIDENT, before commencing the ordinary business, said he would like to say a word on behalf of the President of the Institution of Gas Engineers, as it appeared that in the minds of some of the members there was a little unsettlement at the idea of going to Belfast for the annual meeting. Mr. Blundell hoped that no member of the North of England Association would stay away because he had thought of disturbances in Belfast during the Institution week. Every arrangement possible was being made for the comfort of those who intended to attend the meeting. No one need stay away because of fear.

THE BALANCE-SHEET.

The PRESIDENT submitted the balance-sheet of the Association for the year ended March 31 last, which had been printed and circulated. He moved its adoption.

Mr. HERBERT LEES (Hexham) seconded, and the resolution was carried.

The PRESIDENT moved a recommendation by the Committee that a donation of £10 10s. be contributed to the Benevolent Fund of the Institution of Gas Engineers. He said the Association had made a similar donation annually for some years past, and he felt sure the members would like to see it continued.

Mr. J. KELLY (Bridlington) seconded, and the proposal was agreed to.

NEW MEMBERS.

The following new members and associate members were nominated and declared duly elected: Members, Messrs. Harold Ernest Copp, of Sutton (Yorks); William Roxby, Stanley and District Gas Company; and F. H. Vince, Redheugh Gas-Works, Gateshead. Associates, Messrs. William Scott, of Shotley Bridge, and John Coyle Henderson, of Wallsend.

PAPERS AND DISCUSSIONS.

The PRESIDENT, in introducing Dr. W. B. Davidson to read his paper on "Calorific Value," said he would like to impress upon members, especially the younger ones, the desirability of coming forward with papers at their regular meetings. He hoped that they would have no difficulty in getting a satisfactory number of papers to be read.

Dr. DAVIDSON then read his paper, which is given, together with a report of the discussion, in succeeding columns.

Mr. B. RICHARDSON (North Shields) then read a paper on "Corrosion and Other Deposits in Gas Services." This will be found on p. 348.

VOTE OF THANKS.

On the motion of Mr. W. W. ATLEY (of Stockton), seconded by Mr. A. E. RUFFHEAD (Darlington), the authors of the papers were cordially thanked.

ELECTION OF PRESIDENT AND OFFICERS.

Mr. J. KELLY (Bridlington) was elected President of the Association for the ensuing year; and in returning thanks for the honour, he invited the members to hold the autumn meeting at Bridlington.

Mr. S. Shadbolt (South Bank) was elected Vice-President.

Mr. W. A. Cowley (Spennymoor), Mr. W. Galleway (Whitby), and Dr. G. Weyman (Newcastle) were elected to the Committee; Mr. Norman S. Cox (Sunderland) was re-elected Hon. Secretary and Treasurer; and Mr. C. H. Armstrong (Wallsend) was re-elected Hon. Auditor.

The President and the other officers and committee were thanked for their services in the past year.

CALORIFIC VALUE.

By W. B. DAVIDSON, Ph.D., D.Sc., F.I.C.

GENERAL IMPORTANCE OF THE SUBJECT.

It is questionable if there is any subject of greater importance to the vitality of the human race than calorific value. All the higher forms of life are, directly or indirectly, dependent on the production and supply of heat. The irreducible minimum of fuel in the form of food that must be supplied to the human body in order to maintain its establishment, so to speak, without doing any work or vigorous play, may be measured in so many calories or thermal units per day. It is true that the body may sustain a long fast by drawing upon its stores of fuel in the form of fat and tissue; but this does not alter the broad fact that without food there can be no vital energy.

It would be interesting to consider at length the economics of food, the total quantity required, the best concentration of calorific value in the same, and the numerous qualities to be found ready to hand in our natural surroundings or capable of artificial production. The minimum standard of living with regard to food, when stated in the form of calories per day, is one easily bought when one is willing to live on the very cheapest forms, such as bread, potatoes, rice, and margarine. Generally speaking, the inerts in food take the form of moisture or water; and the approximate calorific value and the cost per therm will be found by calculating to the dry basis. This, of course, is not strictly correct; but it is useful to remember, without pursuing the analogy any further, that the main diluent in foodstuffs is water (in turnips over 90 p.ct., for example), while in gas at the burner head it is nitrogen or air. Highly concentrated foods and fuels are as a rule not wholesome. They upset the digestive apparatus and, except perhaps under highly scientific conditions and careful supervision, make for waste or low thermal efficiency.

Though when we reckon in all the different forms of energy formed or transformed we find there is no net loss in any process of combustion, yet we are confronted with the unfortunate fact that calorific energy always suffers degradation—high temperature heat is converted into unavailable low-temperature heat. The conservation and proper utilization of our stores of available high temperature energy, particularly those of coal and oil, must of necessity form the subject for our frequent serious consideration if we are not to be altogether oblivious to the future comfort of the human race.

CALORIFIC VALUE OF DIFFERENT SUBSTANCES.

By far the highest heating value to be found in elementary substances is that of hydrogen, 1 lb. of which produces on combustion 61,000 B.Th.U., as against 14,600 B.Th.U. for 1 lb. of carbon. Substances containing combustible hydrogen have therefore the highest values in proportion to the hydrogen content, or approximately so; the heat of formation of the compound having to be deducted. The highest percentage of hydrogen is to be found in methane (CH_4), which contains 25 p.ct. and has a calorific value of 23,920 B.Th.U. per lb. [In the gaseous state, hydrogen and methane have densities of 1 and 8 respectively, and the ratio of their comparative values, 320 and 998, is reversed.]

Carbohydrates, like cellulose (seen nearly pure in cotton wool) having the formula $(C_6H_{10}O_5)_x$ and the analytical composition C 44·42 p.ct., H 6·22 p.ct., and O 49·36 p.ct., or ordinary sugar having the formula $C_{12}H_{22}O_{11}$ (C 42·08 p.ct., H. 6·48 p.ct., O 51·44 p.ct.) have a fairly high hydrogen content but a comparatively low calorific value, though free from ash and moisture. This is because the hydrogen is already bound to the oxygen, or, one might say, already burnt; and there is no residue available over and above that required to form water. The result is, the heat of combustion is little more than that calculated from the percentage of carbon. Thus, sugar gives 6944 B.Th.U. per lb.; 42·08 p.ct. carbon being equivalent to 6144 B.Th.U. We find, accordingly, that the younger a coal, or the nearer it is to the original state of wood, the lower its heating value. It goes without saying that the presence of inert matter, in the shape of mineral incombustible ash and water, detracts from the calorific value *pro ratâ* according to content. There are thus three main things which adversely affect the heat of combustion of a coal—high oxygen, high ash, and high moisture content.

When a coal is carbonized at modern high retort temperatures, it gives off practically all its hydrogen and oxygen, which therefore constitute the greater part of the volatile matter (gas, tar, and liquor). Best Durham gas coal and coke, for example, might be said to have the following elementary composition on the dry basis:

—	C.	H.	O. & S.	N.	Ash.
	P.Ct.	P.Ct.	P.Ct.	P.Ct.	P.Ct.
Coal	74·4	6·0	12·0	1·6	5·5
Coke	89·2	0·7	1·2	1·1	7·8

Any further carbonization of the coke at extremely high temperatures will result in an additional yield of gas which will consist almost entirely of hydrogen. The calorific value of dry high-temperature coke, which contains very little hydrogen, is nearly proportional to its carbon content. It is usually considerably (5 to 10 p.ct.) less than that of the dry respective coal, and depends largely upon the ash content of the latter. Some low-temperature cokes, on the other hand, made from lignitious coals low in ash, have a higher value than their respective coals, even in the dry state.

It is well known that the principal criterion of the gas-making quality of a coal is not so much its volatile content and its freedom from ash and moisture, as the content of available hydrogen—that is, the percentage of hydrogen left after deducting $\frac{2{\cdot}016}{16}$, or roughly one-eighth, of the percentage of oxygen present. This is also tantamount to recognizing that the higher the calorific value, the better the coal for gas manufacture. It is for this reason that I would strongly advocate the use of the calorific

value test in addition to the ordinary tests for proximate analysis in the valuation of gas coals. The objection usually raised that heat of combustion does not distinguish between a clean, dry, anthracitic coal on the one hand, and a good gas coal on the other, is not a valid one, as one never looks for a gas coal among those giving a lower volatile content than about 25 p.ct.; and, it may be said, to this extent the volatile content is a useful criterion in judging gas coals. In other words, where inerts (ash and moisture) are comparable in two coals, the test for calorific value will give a good indication as to which is the better gas coal; that with the larger amount of available hydrogen giving the higher test figure.

A formula, such as that of Goutal, is sometimes used for deriving the value of a coal in calories per gramme, or B.Th.U. per lb., from the percentages of volatile matter and fixed carbon found in proximate analysis. Though this may be remarkably close in most cases, it occasionally fails. With proper apparatus and precautions, the actual value may be determined with little difficulty and with absolute reliability.

There are many different kinds of apparatus in use for determining the heating value of a sample of coal. In some calorimeters, such as Darling's, Rosenhain's, and Thompson's, the coal is burnt in a current of oxygen, and the hot gaseous products of combustion are made to give up their heat to the enclosing water by bubbling through it in fine streams. It is, however, difficult in some cases to ensure complete combustion, and they all fail in dealing with coke. Roland Wild's calorimeter consists of a nickel crucible with screw lid, and depends on the combustion of the coal by means of sodium peroxide, which is intimately mixed with it. In this case it is necessary to make a deduction from the total heat for the heat of formation of the sodium carbonate and other salts formed in the reaction. The only apparatus which satisfies all requirements, and in particular ensures complete combustion, is the bomb calorimeter. The Berthelot-Mahler, or some similar type of bomb, is satisfactory. Fig. 1 shows the Mahler-Cook bomb, which is well and robustly constructed. The method of carrying out a determination is as follows: Fine platinum wire is securely fastened across the two stout nickel-wire terminals, as shown. A small silica crucible containing the finely-powdered coal is placed on the ring formed by one of these terminals; and the platinum wire is pressed down so that it remains in contact with the coal. The lid is fitted carefully to the bomb and screwed down, at first by hand and finally by spanner, without exerting too much force. The connections between the bomb and a cylinder of oxygen are made good, and oxygen is allowed to pass slowly into the bomb until the gauge shows a pressure of 25 atmospheres. The cylinder and the bomb valves are then closed, and the cylinder connections are uncoupled. The nickel-plated and burnished calorimeter vessel, containing 2500 grammes of distilled water, is placed inside the jacketed and lagged outer vessel, and into the water is introduced the bomb with firing wires attached. The stirring gear is set in motion and, after two minutes' stirring, thermometer readings are taken every minute for five minutes. The thermometer requires to be a very sensitive one, capable of being read to the thousandth part of a degree centigrade. Preferably a Beckmann differential thermometer, which can be set for any room temperature, should be employed. The bulb should be well immersed, and should not touch either bomb or stirrer. The coal is fired electrically at the end of the fifth minute—the lighting circuit may be used with sufficient resistance. Stirring is quickened somewhat, and thermometer readings are taken every half-minute until the reading is fairly steady; then they are taken every minute for seven or eight minutes. The thermometer and bomb are removed and the pressure in the latter released. The lid is removed and the bomb washed out.

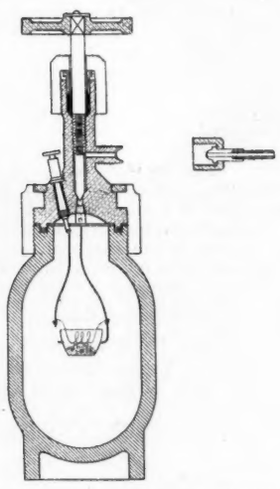


Fig. 1.—Mahler-Cook Calorimeter.

In calculating the rise in temperature, corrections have to be applied for the cooling which takes place during the period of combustion. This rate of cooling is compounded of the rate per minute in the preliminary period, when it may be a rise, and the rate in the final period; and the total correction can easily be calculated by adding up the computed corrections for the various intervals. The apparent maximum reading may not give the true maximum—it depends on the final rate of cooling.

The true rise in temperature, obtained by subtracting the temperature at the time of firing from the calculated true maximum, is multiplied by the water equivalent of the apparatus and divided by the weight, in grammes, of the coal taken to give the number of calories per gramme or calories per kilogramme; and by multiplying by 1·8 we get B.Th.U. per lb.

The combined water equivalent of the bomb, calorimeter containing 2500 grammes of water, stirrer, thermometer, &c., is best obtained, not from their respective weights and specific heats, but by the combustion of definite weights of pure substances of known calorific value—in other words, by doing blank tests on known substances. Pure recrystallized cane sugar, 3958 calories per gramme, may be employed as standard, 2 grammes being used and the average of three successful tests being taken. The product of grammes of sugar and 3958 is divided by the corrected rise in temperature in degrees Centigrade, to give the water equivalent of the apparatus. It will improve accuracy of working if the temperature of the water in the jacket and in the calorimeter at the beginning of a determination coincides closely with that of the room.

In very accurate work a correction should be made for any nitric acid and sulphuric acid which may be formed. The nitric acid arises from partial oxidation of the nitrogen of the air in the bomb, and the nitrogen evolved from the coal; while the sulphuric acid is the product of the partial oxidation of SO_2, the first product of the burning of the sulphur in the coal under the conditions of high pressure and temperature ruling in the bomb at the time of firing. The total correction does not, as a rule, amount to more than 20 calories, or less than 0·4 p.ct., and is, of course, subtractive. It is estimated exactly by washing out the bomb carefully, titrating the total acid, and determining the sulphuric acid as barium sulphate. For every milligram of nitrogen oxidized to nitric acid, 1·05 calories, and for every milligram of sulphur oxidized to sulphuric acid 2·2 calories are deducted from the total calories generated.

It is sometimes preferable to introduce the coal or other fuel in the form of a small briquette, to avoid dispersion in the stream of oxygen.

Good coals give a maximum temperature in four minutes from the time of firing; poor coals, high in ash, may take six minutes. When the ash is bulky or fusible, a small quantity of coal may be occluded. This can be determined by grinding and igniting.

Coke requires to be finely powdered; and a greater oxygen pressure—30 atmospheres—is needed.

The calorific value of tar, oils, and all kinds of fuel can be readily tested for heating power in the bomb; and simultaneously the sulphur may be estimated by first introducing into the bomb about 50 c.c. of pure normal sodium carbonate solution, which is afterwards titrated with HCl and precipitated with barium chloride.

Volatile liquids, such as benzole, may be introduced in a thin sealed glass bulb containing not more than half a gramme of the liquid. After introduction of the oxygen, the bulb is broken by shaking. Other devices are also used.

In the determination of calorific power, it is the gross value—steam condensed to water—that is obtained and stated. The net value, latent heat of steam, and sensible heat of water deducted can only be obtained by determining the amount of water formed in combustion; and this is not often done. It can be done by passing the compressed gases through a drying weigh-tube and sweeping them out with hot dry air, heating the bomb at the same time. A better way is by ultimate analysis of the fuel. The following are the directions and sequence for the actual performance of a test, including an example:

Determination of Calorific Value of Coal by a Bomb Calorimeter.

Take from 1 to 1½ grammes of powdered coal in a small silica crucible.

Weigh into the calorimeter 2500 grammes of distilled water.

Place, in looped or spiral form, 4 in. of special wire between the internal terminals, making sure the contact is good and the wire touching the coal. (For the "Mahler-Donkin" bomb use iron wire of 0·010 in. diameter, and for the "Mahler-Cook" platinum wire of 0·0035 in. diameter.)

Be careful to screw down the cover of bomb without using excessive force.

Admit oxygen slowly, under pressure, until the gauge indicates 25 atmospheres, and close the valve.

Immerse the bomb centrally in the water, having previously adjusted the temperature of the latter so that it is about a degree lower than that of the room.

Connect-up the firing wires.

Place the special thermometer carefully in position so that the bulb is about half-way down in the water and does not foul the stirrer.

Stir the water regularly and continuously for about two minutes until the temperature is steady; then read the thermometer (to nearest 0·001° C.) every minute for five minutes.

Fire exactly at the end of the fifth minute and then stir fairly quickly, reading the thermometer (to the nearest 0·1° C.) every half-minute for two minutes, and then as accurately as possible every minute for at least eight minutes.

Remove the thermometer carefully, and then the bomb. Release

the gases from the bomb. Swill the latter out with distilled water repeatedly and allow it to drain.

Calculation of Rise in Temperature.

Calculate (*a*) the mean rise per minute before firing, and (*b*) the mean fall per minute for a period of at least four minutes after the water has begun to fall steadily in temperature after firing.

Select the thermometer reading which will give the maximum corrected temperature. [This is usually to be found at the fourth minute after firing.]

Add to this reading corrections as follows:

1. The algebraic mean of (*a*) and (*b*) multiplied by the number of minutes elapsing between the moment of firing and the time when the temperature has reached to within about a quarter of a degree of the apparent maximum.

2. The fall per minute (*b*) multiplied by the remaining number of minutes elapsing until the point taken as maximum temperature is reached.

The difference between the corrected maximum temperature and the temperature at the moment of firing is the corrected rise in temperature.

Calculation of Calorific Value.

Calories per Gramme (Large Calories per Kilogramme).—Multiply the corrected rise in temperature in degrees Centigrade by the sum of 2500, and the known or ascertained water equivalent of the calorimeter, bomb, &c., and divide by the weight of coal taken.

B.Th.U. per Lb.—Multiply the above result by 1·8.

EXAMPLE.—Coal Taken, 1·3322 grammes.

Before Firing.		After Firing.	
Time.	°C.	Time.	°C.
2·21	14·527	2·25½	15·2
2·22	14·528	2·26	16·2
2·23	14·529	2·26½	17·15
2·24	14·530	2·27	17·30
2·25	14·531 (fired)	2·28	17·38
		2·29	17·390 × maximum
Rise per minute, 0·001°.		2·30	17·381
		2·31	17·372
Maximum	17·390	2·32	17·364
Add 1½ × 0·0035 . .	0·0053	2·33	17·355 (Fall per minute, 0·008°)
Add 2½ × 0·008 . .	0·020	2·34	17·348
		2·35	17·340
Corrected maximum .	17·4153		
	14·531	(Water equivalent = 600)	
Diff. = Rise (corr.) .	2·8843		

B.Th.U. per lb. = 2·8843 × 3100 × 1·8 ÷ 1·3322 = 12,590.

The correction of gross value to net or lower value is calculated from the water formed on combustion; the water being either weighed directly or estimated from the hydrogen content. As the heat of evaporation of water (latent heat of steam) at 212° Fahr. is 967 B.Th.U., and as 2·016 parts by weight of hydrogen produce 18·016 parts of water, it follows that a deduction of $\frac{18{\cdot}016 \times 967}{2{\cdot}016 \times 100}$ or 86·4 B·Th.U. must be made for each p.ct. of hydrogen present, or 9·67 for each p.ct. of water formed.

In determining thermal efficiency in boiler trials, it is also usual to make further allowance for the water present in the fuel; a deduction from the calorific value as found above being made at the rate of 9·67 for each p.ct. For ordinary steam coals, which border on gas coals, the net value is generally about 3 p.ct. lower than the gross; while it takes about 12 p.ct. of moisture in the fuel to give a further reduction of 1 p.ct.

It would seem to be quite a reasonable proposition to buy and sell coal and coke as fuel on a therm basis. As a matter of fact, however, the size and ash content influence the sale and price to a degree not commensurate with what one would reasonably expect. For example, coal slack commands a price not much more than half that of round coal; while coal dust can be had at a very low figure. Clean coke dust with a calorific value of about 11,000 B.Th.U. per lb. has been advertised in this district recently at the ridiculous price of 1s. per ton on rail, or 0·05d. per therm. This can be made use of for boilers provided with ample grate area and specially large flues or baffle arrangements to prevent the dust creating a nuisance by escaping up the chimney.

The difference in thermal efficiency between fuels of low and high calorific value is not great; but the cost of carriage and handling of the ash is considerable, and must not be overlooked. When the inert matter exceeds 30 to 40 p.ct., the difficulty of sale becomes very great; and steps are generally taken to reduce the ash content by a system of washing.

Prof. Bone has recently described a method of increasing the calorific value of brown coal or lignite for fuel purposes by drying the same by means of the hot flue-gases of the boilers, at the same time causing partial carbonization, with the production of carbon dioxide and water of combination, without serious loss of combustible gas. There is thus a dual concentration effect.

TOWN GAS.

Gas engineers are now practically compelled to think in therms. Formerly it was too often the chief ambition to increase the make per ton regardless of quality, as if there were only one factor in carbonization—namely, cubic feet of gas. Anyone engaged in the valuation of coals kept the production of thermal units well in view, even if he had to work to an obsolete candle-power standard; and he knew how to classify coals according to their yield of gaseous therms. To him the Gas Regulation Act of 1920 was nothing new. But the director, or member of gas committee, and possibly secretary, knew only of a certain yield of cubic feet of gas per ton of coal; the other equally important factor of quality, taken as probably satisfactory, being ignored. Thus unfair comparison as between one undertaking and another was commonly made. There was some excuse in ignoring the candle power in the midst of a bewildering array of absurd Argand burners; but there can be none for failing to appreciate that heat units have to be supplied, and not merely cubic feet of gas of uncertain heat content.

While the gas engineer cannot be too grateful for the enthronement of calorific value by a broad-minded, sensible Government, he has, in my opinion, a right to complain of the retention of some of the old conditions of testing. I refer specially to correcting to 60° Fahr. and 30 in. barometer. The average consumer does not receive gas at anything like 60° Fahr.; the mean temperature of the gas delivered at the district meters having a temperature of about 45° to 48° Fahr. As moist gas increases in volume approximately by 1 p.ct. for a rise of 4° Fahr., it follows that the supplier is deprived of a legitimate 3 p.ct. In other words, the Act compels him to deliver 12 to 16 B.Th.U. per c.ft. more than the consumer actually pays for.

This is probably an oversight on the part of the Board of Trade, for in the report of the Fuel Research Board dated Jan. 29, 1919, clause 20 states: "We believe that the interests of the consumers can best be conserved if their contract with the gas undertaking is based on the sale and purchase of heat energy measured in fixed units which can be scientifically determined by simple means. We propose therefore that the consumer should be charged for the thermal units which he actually receives, in the same way as the consumer of electricity is charged for the Board of Trade units which pass through his meter."

To ascertain the thermal units in the gas received by the consumer, the test ought, in my opinion, to be carried out under conditions representing reasonably closely those prevailing in the district of supply, without making any correction for temperature or pressure. In all cases there will thus be a definite gain to the gas undertaking in the matter of temperature. Where towns or districts are situated well above sea level, there will be a slight loss due to pressure, amounting in Birmingham, for example, to 1 p.ct. In every case it will mean a net gain and fair play.

Another thing which annoys a student of therms is the different values, found in gas literature, attributed by different people to the combustible gases, carbon monoxide, hydrogen, and methane. It is, of course, inexcusable to use academic or Continental figures referring to gas at 0° C. and 760 m.m., or dry gas at 0° C. and 760 m.m., when the volume is registered at 60° Fahr. and 30 in. It would not matter a great deal if gas were always tested by calorimeter; but one frequently finds that the quality is judged by the analysis of a sample. The reliability of gas analysis is none too great. It is particularly difficult, for example, to absorb all the carbon monoxide, any residue of which is burnt to carbon dioxide and therefore recorded as methane with three times the value.

I had occasion to draw attention to this point in this room two years ago. The possible error is seen to be a rather serious one when you note that the factor for converting dry gas at 0° C. and 760 m.m. to moist gas at 60° Fahr. and 30 in. is 1·073—that is, there is a difference of over 7 p.ct. between the two sets of figures, or, on normal gas, 35 B.Th.U.

As regards the values to be taken for moist carbon monoxide, hydrogen, and methane at 60° Fahr. and 30 in. mercury, I accept the following data:

The gramme-molecule, 28 grammes, of carbon monoxide, CO, gives a heat of combustion of 68,000 calories.

The gramme-molecule, 2·016 grammes, of hydrogen gives a heat of combustion of 68,400 calories (water liquid)
or 57,600 ,, (water gaseous)

The gramme-molecule, 16·032 grammes, of methane gives a heat of combustion of 211,930 calories (water liquid)
or 190,330 ,, (water gaseous)

From these data, after applying all the necessary corrections for temperature, pressure, and moisture, we get:

	B.Th.U. per Cubic Foot at 60° Fahr. 30 in. Moist.		
	Gross.		Net.
Carbon monoxide	320	..	320
Hydrogen	321	..	269
Methane	998	..	897

I am open to correction with regard to the above and am aware that the selection of the values for the heat of combustion is to a certain extent a matter of choice. We require an accepted standard.

I beg leave to introduce to your notice a new gas calorimeter (fig. 2, p. 348). This is of the usual cylindrical vertical pattern. It is extremely simple in design, and consists essentially of a gas-burner, a small scrubbing tower, and a water distributor. The packing of the scrubber consists of thin strips of copper wound in spiral form so as to expose as large a wetted surface to the hot gases as possible, and at the same time to leave a large gas way which will not impose much resistance or back pressure. The water distributor consists of a circular movable plate carrying taper pins which pass through small holes in another flat circular plate. These taper pins or needle valves are capable of being raised or lowered by a slow-movement screw; and the effect is to allow water in the top chamber to fall on to the packing dropwise from about 150 points.

The instrument has practically theoretical efficiency—say, 99·9 p.ct.—and has the advantage of great simplicity and low cost. It

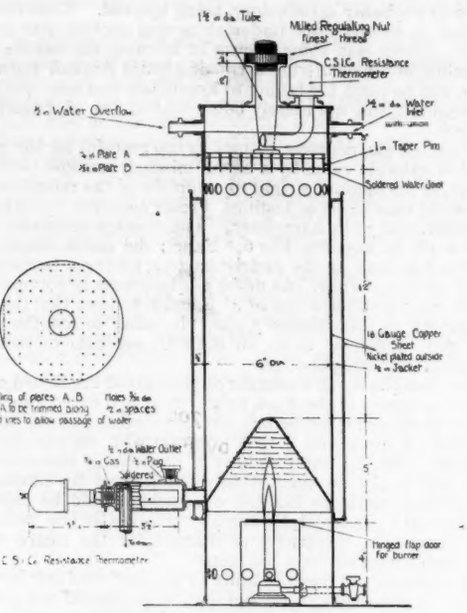

1½ in. dia. Tube
Milled Regulating Nut fine screw thread
C.S.I.Co. Resistance Thermometer
½ in. Water Overflow
½ in. dia. Water Inlet with union
¾ in. Plate A
⅛ in. Plate D
1 in. Taper Pin
Soldered Water Joint
12"
16 Gauge Copper Sheet Nickel plated outside ½ in. Jacket
6" dia.
Drilling of plates A, B. Plate A to be trimmed along dotted lines to allow passage of water
Holes ⅜ in. dia. 2 in. spaces
½ in. Water Outlet
¾ in. Gas ½ in. Plug Soldered
5"
Hinged flap door for burner
C.S.I.Co. Resistance Thermometer

Fig. 2.—A New Type of Gas Calorimeter.

may be fitted with thermometers or with electrical resistance thermometers indicating, or recording, gross value. It is intended only for gross value. The accessories (gas-meter, water measure, &c.) are the same as for the ordinary gas calorimeter.

Modern Tendencies in Choice of Calorific Value.

We must admit that the Board of Trade allowed wide scope for choice of value under the 1920 Gas Act. The first tendency was to reduce the standard considerably; 450 gross being the most popular figure. This allows full advantage to be taken of steaming in vertical-retort plants. A number of undertakings possessing auxiliary carburetted water-gas plants apparently have found the recent low price of gas oil favourable to the manufacture of high-grade gas, and have maintained a high figure or raised their original declared standard. A return to the old high values of 600 and over would be deprecated on account of the difficulty of securing proper aeration at the burner, and maintaining high flame efficiency.

It is interesting to speculate as to what the town gas of the future will be. Some pin their faith to straight coal gas; others to water gas; others, again, to mixed gas obtained by complete gasification. Undoubtedly, the cheapest gas that can be manufactured is producer gas. (Needless to say, I refer to cost per therm.) In my experience, this is obtainable at less than half the cost of coal gas. The cost of its distribution, however, is generally considered to be prohibitive. Credit must be given for the much lower degree of aeration required as compared with coal gas, requiring considerably less pressure at the injector nipple of the bunsen burner. Probably the maintenance of a much higher general pressure in the mains, with governors on each service-pipe, would overcome any difficulty of supply.

Producer gas has a comparatively low flame temperature, which has a prejudicial effect on incandescent lighting and the radiation of a gas-fire, though scarcely affecting other domestic uses. Some of us are looking to the introduction of cheap oxygen on a large scale for the toning-up of producer gas into a thoroughly satisfactory gas which will satisfy all demands as regards price and efficiency.

This is a time, it may truly be said, for the gas industry to bestir itself, so as quickly to realize its proper functions in domestic and industrial life.

Discussion.

The President said they had heard a very valuable paper from Dr. Davidson. It went to show, as he had often said, the importance of gas engineering as a branch of chemical industry. He had no doubt that many of them, as Dr. Davidson had suggested, would like to purchase their coals on a calorific basis. The only thing missing from Dr. Davidson's paper was the name of a colliery who would sell coal on a calorific value.

Dr. G. Weyman stated that the question of buying coal on thermal value was very attractive, but it did not go far enough. It was, however, a good starting point towards buying coal on a definite calorific value; for by buying on this basis they were buying therms, and it would be their own fault if they did not get the therms out. It did not follow that they would get therms out in the form of gas. If they did not get therms in the form of gas, they would get them in coke or tar; if it were otherwise, it was bad workmanship. It was an attractive scheme. To limit the volatile matter was also a good argument. He was attracted by Dr. Davidson's new type of calorimeter, which seemed simple and efficient. He would like to know how Newcastle water would act upon it. This water was pure enough to drink, but it was not, he thought, pure enough for calorimeters. The water was slightly alkaline as well. One feature in producing gas that appealed to him was that it was easier to get efficiency in producer gas, because it was so much easier to mix the air with the gas. With coal gas they had to mix five or six times the amount of air. He used gas coke for many years, and got on with it very well; but he stopped it when he found that he could get coal cheaper. It was a question of pounds, shillings, and pence. He did not think solid fuel would ever be displaced. It was easily handled and stored. There was a world-wide market for coke. The thing was to bring the coke to the market; it was a valuable commodity, and easily combustible. He thought it would be possible to produce a coke as easily combustible as coal, and by methods very similar to those in use to-day.

Mr. S. Shadbolt (South Bank) said that during the last twelve months he had tested coal by a Darling calorimeter, which had given a remarkable index of the coal submitted. It was encouraging to find confirmation of a line of thought he had been following. It had avoided the inconvenience of a test on trucks of some stuff which would have been condemned by a laboratory test. He hoped they would live long enough to appreciate what he described as Dr. Davidson's exposure, and trusted that it would enable the gas industry to get something nearer justice.

Mr. J. Kelly (Bridlington), in regard to altering the standard of calorific value, thought it would be a good thing if the various authorities could be induced to do what Dr. Davidson suggested. With regard to coals, since the trouble abroad, they had experienced a great difference in the quality of the coal delivered at gas-works. The ash content had not decreased, and the volatile content was not increasing. If the collieries could be induced to sell on a thermal basis, this would have considerable effect on the price the collieries would want for the coal. They might not be much better off at the finish. It was a courageous paper. He did not quite agree with what had been said regarding the distribution of producer gas. This was rather a question of the conditions under which they distributed. The great point was the price at which they could supply the therms to the consumer.

Dr. Davidson, replying to the discussion, said the calorimeter which he had introduced was acid proof; and by using proper material for packing, the life of the instrument should be satisfactory. Dr. Weyman had spoken of the difficulty of testing under conditions actually present in the consumer's meter, saying that the works meters were not under the same conditions as the consumers' meters. Dr. Davidson did not think that this had anything to do with the case. It had really nothing to do with getting the consumer to pay for what he received. He maintained that the consumer ought to pay for what he was actually getting. As it was, the consumer got 3 or 4 p.ct. more of calorific value than he was supposed to get, and most people did not know it. He thought the gas industry was entitled to this amount. Dr. Davidson went on to say that he could not tell what effect Newcastle water would have on the calorimeter. As to Dr. Weyman's preference for coal over coke, Dr. Davidson thought if he was in favour of smoke abatement, then a few shillings should not be considered. It was a matter of principle. Dr. Davidson wanted smoke abatement. This was a matter they would have to keep before them. As to the calorific value of various kinds of coal, he thought that, if they were dealing with certain coal, they could rely on getting better gas results. They must study the nature of the coal and the seams. The calorific value was the best possible criterion. The bogey of corrosion in mains had been often used. They had had it for twenty or thirty years at least, and through all the time it had not done a great deal of damage. More damage was done by naphthalene than all the other corrosions. Regarding the distribution of producer gas, he thought it was a subject somebody should take up. It would form a good topic for a debate. Some gas engineer should go into the matter carefully, and give them a paper on his investigations. It was not possible for him to go into the question very closely. He mentioned it as a suitable theme for discussion.

CORROSION AND OTHER DEPOSITS IN GAS SERVICES.

By Mr. B. Richardson, of North Shields.

If a gas undertaking is to render the best possible service to its consumers, it is necessary that it should, at all times and in the most varied conditions, be able to maintain an adequate supply of gas of approximately constant calorific power and composition. This is a truism which will be admitted by all without question. At the same time it must be confessed that it is one which may be regarded by some as Utopian and incapable of realization in practice. Yet, on regarding the great and vigorous gas industry, it is evident that, slowly but surely, it is approaching the stage when these ideals will be within measurable distance of attainment.

The advent of the vertical retort, the improvements effected in horizontal installations, the supplanting of rule-of-thumb methods by skilled supervision, and the attention now paid to a thousand-and-one details which formerly were neglected—all these have resulted in a straightening of the line traced out by the engine-room recording calorimeter, so that to-day it is within the bounds of practical policy to turn out a gas which varies, at most, by some 20 B.Th.U. from the declared calorific value.

The task of the gas producer does not, however, end here. Having manufactured a suitable gas, it is his next task to see that it is distributed as free as possible both from corrosive constituents, which may attack the iron and metal work of the service pipes or meters, and from compounds liable, by reason of their physical properties, to condense in a solid form in the mains and so partially or completely obstruct the flow of gas. In the course of the past three or four years many interesting examples of the work of the first class of agents have come under my notice; and have been submitted to chemical examination. They occur principally in steel, cast-iron, and wrought-iron services of 4 in. in diameter and downwards; and are frequently found in lead pipes fixed to the inlet of consumers' dry meters

and in the interiors of the meters themselves. High-pressure steel mains are particularly susceptible to their malign attention; while some time ago a 3-in. cast-iron low-pressure main was found almost completely choked with what, on analysis, proved to be iron rust and ferric ferrocyanide or prussian blue. The rust was deposited in thick layers round the interior of the pipe; each layer being separated from the next by exceedingly thin laminæ of prussian blue, so that a cross-section with its dark concentric rings presented an appearance closely resembling the cut end of a tree trunk. I append the analysis of the specimen, a typical example of its kind:

	P.Ct.
Moisture	3·65
Free sulphur	Tr.
Ammonium sulphate	0·70
Iron as Fe_2O_3 and Fe_3O_4	91·80
Ferric ferrocyanide	3·80

From this it will be seen that the substance may be regarded as impure ferric oxide with about 4 p.ct. of prussian blue or ferric ferrocyanide, which is about the average I have found in these voluminous scaly deposits. Samples of dust collected from high-pressure governors have contained very much more than this (10 p.ct., 12 p.ct., and even 15 p.ct. being common figures); while dust removed from a choked ⅛ in. brass gas-pipe has been known to consist of more than 50 p.ct. ferric ferrocyanide.

The prussian blue is, of course, derived from the hydrocyanic acid present in the gas. Crude coal gas may contain anything from 30 to 80 grains of this impurity per 100 c.ft.; light charges worked at high temperatures yielding the largest quantities. It would appear to be produced during the last stages of carbonization; and some maintain that it is synthesized in the retort from carbon, nitrogen, and hydrogen according to the equation:

$$2C + H_2 + N_2 = 2HCN.$$

Others hold that it results from the interaction of carbon monoxide with ammonia:

$$NH_3 + CO = HCN + H_2O.$$

There is, however, no positive evidence, beyond that afforded by laboratory experiment, that such reactions occur on the large scale. Hydrocyanic acid is not the only volatile cyanogen compound produced during the distillation of coal, for benzole first runnings always contain isocyanides or carbamines in appreciable quantity; so that frequently ironwork with which they come in contact soon assumes a blue coating of ferric ferrocyanide. The bulk of the hydrocyanic acid in coal gas is removed by the oxide purifiers; and purified town gas contains only some 2 to 8 grains per 100 c.ft., which does not seem a sufficient quantity in itself to bring about the large accumulations of corrosion deposits so frequently met with during the past few years.

It appears clear that there are three agents destructive to ironwork, in comparison with which all others play a secondary role. These are water, carbon dioxide, and oxygen; corrosion always taking place at the dewpoint, moisture being essential for the reactions. Accordingly, when water is deposited in the service, this, in conjunction with the carbon dioxide (present to the extent of *circa* 1500 to 3000 grains per 100 c.ft.) and the oxygen in the gas interact with the iron.

Hydrated ferrous carbonate is first of all produced,

$$Fe + 2H_2O + CO_2 = FeCO_3, H_2O + H_2,$$

which is next oxidized by the oxygen with the formation of ferric oxide and the liberation of carbon dioxide;

$$4FeCO_3, H_2O + O_2 = 2Fe_2O_3 + 4H_2O + 4CO_2$$

or triferric tetroxide (magnetic oxide of iron) may be produced:

$$6FeCO_3, H_2O + O_2 = 2Fe_3O_4 + 6H_2O + 6CO_2$$

The formation of prussian blue would seem to take place as the result of the interaction of hydrocyanic acid and hydrated ferric oxide, a complicated cycle of chemical changes taking place, which for the sake of simplicity may be represented by the following equations:

$$2Fe_2O_3, H_2O + 8HCN = 4Fe(CN)_2 + 6H_2O + O_2$$
$$18Fe(CN)_2 + 3O_2 = 2Fe_2O_3 + 2Fe_7(CN)_{18}.$$

According to these, the hydrocyanic acid is represented as attacking the ferric oxide, forming, in the first place, ferrous cyanide, which is subsequently oxidized to prussian blue.

Practically all corrosion deposits consist of masses of ferric hydroxide—some ferrous carbonate if fresh—triferric tetroxide, and a covering film of prussian blue. They frequently retain the form of the water drops, which on condensing initiated the trouble.

As time goes on, more of the ferric oxide is attacked by the hydrocyanic acid; and the percentage of prussian blue increases. Then disintegration ensues; and the resulting dust is carried forward by the gas stream until, if the corrosion has taken place in the high-pressure system, it arrives at the governors, where it accumulates and causes trouble. In low-pressure distributing systems the dust frequently chokes the smaller pipes in dwelling houses, and is often found in lead pipes at the inlet to consumers' meters. The lead pipes themselves are also liable to corrosion by carbon dioxide and oxygen in the presence of moisture, lead carbonate being the principal result of the action; while smaller amounts of ammonium thiocyanate, lead sulphate, and lead thiocyanate are also produced.

The elimination of hydrocyanic acid on the works appears to be eminently desirable; for there is no doubt that it does considerable harm by augmenting corrosion trouble, by coating the oxide in the purifiers with prussian blue, thereby reducing its efficiency, and by fouling the water in gasholder tanks. A series of experiments carried out for me by Mr. P. D. Scott, B.Sc., showed that, while town gas at the outlet of the holder contained 3·97 grains of hydrocyanic acid, at the most distant points of the district the amount had fallen to 1·80 grains; so that about 55 p.ct. had disappeared as the result possibly of reaction with the ironwork of the services. At the same time it seems to me that freedom from corrosion troubles would not follow upon the removal of hydrocyanic acid. The cure for these evils lies in distributing a gas containing the minimum quantities of oxygen and carbon dioxide; and specially is it desirable that dilution with air should not be practised. During the war, through stress of circumstances, it was common to find gas being manufactured containing 6 p.ct. of carbon dioxide, and 2, 3, and even 4 p.ct. of oxygen. As a direct result, corrosion trouble increased considerably and pipes were choked with scales of rust for long distances. A case is known of a 3 in. steel high-pressure main being very badly attacked during the war period when the gas was carrying excessive quantities of oxygen and carbon dioxide, and which had been stripped of the bulk of the hydrocarbons suitable for lubricating the interior surfaces of the services. A new main brought into use after the cessation of hostilities was found, however, after four years service, to be in practically as good a condition as when it was first laid. This, without doubt, was due to the better quality of gas it had conveyed, a gas which on the average contained not more than 0·5 p.ct. of oxygen and 3 p.ct. of carbon dioxide. The figure for hydrocyanic acid in this particular instance was about the same in 1922 as it was in 1917 to 1918—namely, 3 grains per 100 c.ft.

The conclusions to which a consideration of the above facts leads one are, I think, the following:

1.—Corrosion is primarily due to the combined action of water, carbon dioxide, and oxygen on the ironwork of the mains.
2.—The deleterious effect of hydrocyanic acid in this connection appears to have been over-estimated.
3.—Corrosion deposits are most frequently found in those cases where excessive amounts of oxygen and carbon dioxide are allowed to go forward into the services, and where the gas does not contain sufficient hydrocarbons to form a protective coating on the mains.
4.—The most obvious cure is to limit the oxygen content to the absolute minimum, and to keep the CO_2 figure as low as possible by the avoiding of "overpulling" and consequent inclusion of furnace gases at the retorts. It is also extremely advisable to practise complete ammonia recovery, as this compound forms with CS_2 products which are corrosive to ironwork.

Reverting for a moment to the question of the elimination of hydrocyanic acid from coal gas, it may be said that up to the present there has been no method of extraction devised which could advantageously be applied impartially to both large and small gas-works, though the polysulphide process of the British Cyanides Company appears to be one of the most efficient and economical in use. The hydrocyanic acid is removed as ammonium sulphocyanide by means of ammonium polysulphide in a vessel resembling the ordinary type of oxide purifier but placed before the ammonia scrubbers. The crude gas enters at the base, preferably after passage through a tar extractor, and bubbles through a seal of cyanide liquor. It then traverses a layer of spent oxide about 2 ft. in depth, evenly arranged on a tier of wooden grids. The oxide to give the most satisfactory results should not contain less than 50 p.ct. of sulphur; and it is kept in a damp condition by water sprays disposed round the vessel above the oxide. It is only necessary to spray the latter for a short period each day either with water or weak cyanide liquor. The ammonium polysulphide is formed in the oxide itself by the interaction of the hydrogen sulphide and ammonia in the gas with the free sulphur

$$2NH_3 + H_2S + S = (NH_4)_2S_2.$$

This immediately combines with the hydrocyanic acid to form ammonium sulphocyanide

$$(NH_4)_2S_2 + HCN = NH_4CNS + NH_4HS.$$

The solution of sulphocyanide trickles through the mass and drops to the bottom of the vessel, from which it escapes by means of a seal to the ammonia liquor storage wells.

The process would be practically a continuous one did not the physical condition of the spent oxide necessitate a periodical change; for it is found that no diminution in the sulphur content of the latter takes place—on the contrary, an increase is sometimes noticeable. About six months appears to be the normal period during which the material can be used; and one ton of spent oxide should remove the whole of the hydrocyanic acid from 350 to 400 tons of coal. A small proportion of oxygen (0·3 p.ct.) is necessary to oxidize the ferric and ferrous sulphides in the oxide, and so provide a supply of free sulphur which is, of course, essential to the satisfactory working of the process. The liquor produced contains from 2 to 4 lbs. of ammonium sulphocyanide per gallon and can be mixed with the stock of ammoniacal liquor, and worked-up in the sulphate of ammonia plant in the ordinary way.

With regard to the second class of deposit mentioned, naphthalene is, of course, the chief offender; and it has rightly been described as the *bête noir* of the gas engineer. Methods for its elimination or for rendering it innocuous are legion; but the only satis-

factory manner in which to dispose of the bugbear is to wash it out of the gas with a suitable absorbent before it leaves the works. This solvent may be creosote, anthracene, or water-gas enriching oil; and as intimate contact of the absorbing medium with the gas is necessary for complete removal of naphthalene, a rotary scrubber yields the most satisfactory results. Scrubbers of the tower type are not so efficient, and rarely extract the last traces of the compound; while Livesey washers are quite unsuitable for this work. On the works of the Tynemouth Gas Company, a 1½ million, eight compartment rotary scrubber, originally used for the extraction of ammonia, is employed for the purpose of naphthalene removal; water-gas oil being used as the stripping medium. Up to 1,750,000 c.ft. of gas per day have been successfully dealt with by this plant; the gas at the outlet being quite free from naphthalene, though the inlet gas contains from 8 to 16 grains per 100 c.ft. The amount of oil necessary to effect complete removal under these conditions is equivalent to 35 gallons per million; but when the scrubber has been working well within its rated capacity—*i.e.*, treating 1,200,000 c.ft. per 24 hours—the oil used has worked out as low as 16 gallons per million. No diminution in the calorific power of the gas, after its passage through the scrubber, can be detected.

The oil used is a Mexican variety of sp. gr. ·865 at 15·5° C., and gives on distillation 85 p.ct. below 360° C., the first drop occurring at 200° C. It is very fluid, contains no naphthalene, and can absorb up to 11 p.ct. of this compound. For complete extraction it is necessary to run it through the scrubber in counter-current fashion at such a rate that the spent oil removed contains approximately 7 p.ct. The oil is then employed on the carburetted water-gas plant, as it has been found that no increase in the naphthalene content of the latter results from its use. The average quantity found in the gas at the water gas condenser outlet, whether the oil used for enriching has been through the naphthalene washer or not, is about 12 grains. In actual practice the quantity of spent oil produced from the washer (250 to 500 gallons per week) constitutes only a small fraction of the total amount consumed on the water-gas plant, so that it is invariably mixed with fresh gas oil to bring the naphthalene content down to 1 p.ct. or less.

It has been suggested in some quarters that the use of an oil containing naphthalene in the carburettor of a water-gas plant would tend to cause excessive deposition of carbon upon the chequer bricks, though why naphthalene should be singled out from among the various hydrocarbons comprising a gas oil for attack is hard to understand Mexican and Texan oils contain a large proportion of closed chain compounds, the thermal degradation of which would be more liable than naphthalene to cause carbonaceous deposits. Moreover, under the conditions prevailing in the carburettor, there is little chance of any decomposition of naphthalene ensuing; while, on the contrary, considerable amounts may be produced.

Experiments conducted on our plant have shown that, when using a quantity of oil equivalent to 1 gallon per 1000 c.ft. of gas, it is necessary to crack this at a temperature not less than 1200° Fahr. (650° C.) if the best results are to be obtained. Under these conditions a gas of approximately 400 B.Th.U. is made; but at the same time it is accompanied by much naphthalene, so that at the outlet of the condenser there is seldom present less than 12 grains per 100 c.ft. The tar produced contains up to 15 p.ct. by weight. By reducing the carburettor temperature, the naphthalene disappears, but the calorific value of the gas also suffers, and considerable volumes of unaltered oil make their appearance in the separator. It is necessary therefore to choose the lesser of two evils and work the carburettor at about 1250° Fahr.

At Tynemouth, naphthalene extraction is carried out on coal gas only, the water gas entering the holder without treatment, so that the mixed gas distributed to the town contains about 0·8 grains of naphthalene per 100 c.ft. If it had been possible to wash the entire make with gas oil, total elimination would have resulted. As it is, naphthalene complaints have been practically non-existent during the past winter, the gas leaving the works never carrying anything like the quantity of naphthalene necessary for saturation. The net cost of the process described works out at 0·133d. per 1000 c.ft.; and when this is compared with the sums that are frequently expended in clearing gas mains and services, it will be agreed that it is commercially an attractive proposition.

Gas oil can also be used for naphthalene extraction on works not manufacturing water gas; the naphthalene being extracted from the spent oil by steam distillation, and the latter used again, though perhaps a steam-distilled creosote would prove a more suitable medium for these undertakings to employ. Certain it is that if naphthalene extraction is practised intelligently and under scientific supervision, it will save considerable trouble and expense incurred by the distribution department in clearing the mains and services, and also do much toward ensuring that the consumer receives an adequate supply of gas at all times. This is essential in these competitive days if he is to be prevented from seeking elsewhere the energy that he requires to provide him with light and heat.

Discussion.

The President said he greatly appreciated the value of Mr. Richardson's paper. He expressed his personal thanks to the author for having stepped into the breach when a paper which had been promised was not forthcoming, owing to the illness of a member who was to have read it. Most of them had come across the bugbear of corrosion and deposits, not only in mains and services, but in meters. A close perusal of Mr. Richardson's paper might help to remove these difficulties.

Mr. Bernard R. Parkinson (London) greatly appreciated the invitation to attend the meeting. He had listened to the paper with much interest. While it was written very much on the same lines as the reports of Mr. J. G. Taplay for the Life of Gas-Meters Committee, it carried them a stage further, and, perhaps, showed the case now in a little better perspective. Mr. Taplay's work was begun under the shadow of war conditions; and this was why he laid so much stress on the deleterious effect of products of the interaction of carbon bisulphide and ammonia. As it was unusual in normal gas practice to pass even a trace of ammonia into the distributing mains, Mr. Richardson had rightly dismissed these agents with a caution. Mr. Taplay had put hydrocyanic acid first as an agent of corrosion from a strictly chemical point of view, though as a practical issue Mr. Richardson might be right in relegating it to second place. To the gas manager, it was reassuring to have oxygen and carbon dioxide placed in the forefront, as these were constituents which he could more easily control. All these corrosion reactions took place in the presence of moisture, and he (Mr. Parkinson) would like to see a paper read on the subject of temperature and condensation in the distributing mains. So far no prescription had been given for preventing condensation in low-pressure mains; but with high pressure the remedy was to raise the gas to a higher pressure than was required for transmission, and cool it on the works before reducing the pressure into the mains. He hoped Mr. Richardson would agree that the corrosion in high-pressure mains was due to greater condensation under pressure. He was interested to read of the process for eliminating hydrocyanic acid from coal gas, and to compare it with Mr. Taplay's chalk process. The processes appeared to be very similar except that, in place of chalk, there was spent oxide. The setting of each was between the tar extractor and the ammonia washer. He would like to ask Mr. Richardson on what scale the polysulphide process had been carried out, and whether difficulty had arisen from the tar.

Mr. G. E. Anderson (Wallsend) expressed surprise at the prominence given to carbon dioxide as a destructive agent. Oxygen and water were the other two agents. In the suggested explanation for the processes taking place during the formation of the deposit, carbon dioxide played a leading part; but, personally, he had known oxygen and moisture between them were capable of converting iron into rust without the assistance of carbon dioxide.

Mr. W. E. Oulds (North Shields) referred to causes of obstruction in pipes, and said most Prussian blue was found in the war period. In 1919, the number of stoppages from all causes in connection with his gas undertaking reached 17,000; in 1920, these were reduced to 11,590, in 1921 to 7500, and in 1922 to 3100. In the past four months the stoppages totalled 365. This was something achieved. The corrosion in steel mains had been arrested; but though the number of obstructions had been reduced, the lower figure was only a little smaller than from 1908 to 1912. He did not regard his remarks as any testimonial for low-grade gas.

The discussion was continued by Mr. E. Nicholls (Newcastle), and Mr. A. C. Hovey (Newcastle).

Mr. Richardson, replying, said that if some means could be devised for eliminating water condensation, no doubt the corrosion trouble would be largely solved. It had been shown, he added, that rust was very much accelerated by the presence of carbon dioxide. Replying to Mr. Parkinson, he said that in the polysulphide process for eliminating hydrocyanic acid there had been some difficulty arising from the presence of tar.

Combination Gas and Oil Heating.

Writing in the "American Gas Journal," Mr. J. E. Bullard puts forward a suggested combination of gas and oil as one means of solving the house heating problem. He remarks that the greatest obstacle in the way of carrying out house-heating by gas in a big way is the peak demand. There is only one coldest day in any winter, and everything must be designed to take care of a maximum demand which lasts but a few hours. If burners could be installed that would be used steadily twenty-four hours a day through the full heating season of (say) six months, this would be very desirable business for the gas company. It is perfectly feasible, and to the advantage of everyone concerned, for the gas industry to develop a house-heating load which is uniform throughout the winter—or, at any rate, very nearly uniform. It is merely a matter of letting some other form of fuel take care of the peaks, and installing gas-burner capacity sufficient only to take care of the steady load. A good number of the oil-burners designed for house-heating can readily be adapted to combination gas and oil heating. A gas-burner may be installed that will by itself take care of all the heating requirements on the warmer days; and if in connection with the gas-burner there is used an oil-burner, the most efficient operation of which depends upon some heat being derived from the gas-burner, it becomes necessary for the consumer to use the gas all the time. By using the gas heat as a sort of auxiliary to the oil-burner, a problem in oil-burner design is solved. It becomes possible to make an oil-burner that requires no electric motor to maintain an air pressure for the purpose of atomizing the oil, no pressure on the oil supply, and no unstable and more or less unsatisfactory method of vaporizing the oil if no pressure on the oil or air is used. The gas-burner can be made to do all that must be done for the oil to burn efficiently and without smoke. There is reason to believe that such a combination burner will make it possible to bring the cost of oil and gas heating of this character down to a point where, all things being considered, it will be no greater than that of heating with coal.

RECENT DEVELOPMENTS IN CONNECTION WITH GAS-FIRED STEAM-BOILERS AND THE UTILIZATION OF WASTE HEAT FOR STEAM-RAISING PURPOSES.

By Major W. GREGSON (late R.E.), B.Sc. (Eng.), A.M.Inst.C.E., A.M.I.Mech.E., &c.

[A Lecture to the London and Southern District Junior Gas Association, April 27.]

The whole question of steam generation is one of vital importance to the gas industry, and to deal with this subject adequately is quite outside the scope of a short lecture such as I intend giving this evening. I propose, therefore, to limit my remarks to two sections of the general subject, and must, furthermore, curtail my descriptions of plant to selections from the list of installations with which I myself, in co-operation with my colleagues, have been connected. Otherwise it will be realized that to compress even two branches of the study of steam production into an evening's short talk would mean too brief a scanning of the subject itself.

The two sub-sections dealing with steam generation which I want to speak about to-night are: (*a*) Steam production from gaseous fuels, and (*b*) steam production from waste heat; and I want to confine my remarks as far as possible to deal directly with gas-works practice.

THE NEED FOR SPECIAL DESIGN.

The general run of boilers to-day are constructed primarily for solid fuel firing—*i.e.*, for coal or similar fuels. Any of our modern types of boiler (water tube and Lancashire and allied classes) are steam-raising units which owe their present design to years of careful technical investigation coupled with long experience in running practice; and they are indeed among the highest classes of representatives of modern engineering development. Their finest all-round performances, however, are invariably reached when firing with coal, for the very excellent reason that coal is the fuel that they are designed for. The one exception is that these boilers often give equal—and in certain special conditions even better—performances on gaseous fuel (for obvious reasons, gas being an ideal fuel); but, on the other hand, when waste heat recovery is tackled, it is vital to review the whole situation from an entirely new aspect, as the primary conditions are so completely different.

Surely, it is good economics to obtain the best results possible from each individual fuel; and it is for this reason that I am confining my attention to-night to boiler plant expressly designed for certain fuels.

Gaseous fuels vary in calorific value, from natural gas down to blast-furnace gas; the relaiive calorific values of these two extremes being approximately 10 to 1. Gases intermediate in the scale include coke-oven gas with its, to all practical purposes, "double"—town gas, water gas, and producer gas; and it is these last three gases which are of the most interest to you.

THE GAS-FIRED BOILER.

THERMAL EFFICIENCY.

I will now turn to the subject of the gas-fired boiler itself. The unit I wish to describe briefly to you is a special boiler which owed its origin to experiments carried out to obtain the highest thermal efficiency from the process of burning gas for the production of steam. I refer to the "Bonecourt" boiler—a boiler named from its original inventors (Prof. Bone, late of Leeds University, now of the Royal College of Science, and one of the best-known authorities on fuel in the world; and the late Lieut. C. D. McCourt). The first boiler was a typical laboratory unit. This was quickly followed by two larger boilers installed at the Skinningrove Iron-Works to work on coke-oven gas; and exhaustive trials showed that this class of boiler possessed, in ordinary working conditions, an over-all thermal efficiency of over 90 p.ct. In these early plants, each boiler consisted of a drum containing a number of short tubes filled with refractory packing, a mixture of gas and air was directed into each tube, where the mixture combined on the surface combustion principle, the resultant radiant heat from the refractory packing escaping to the water in the boiler in company with part of the sensible heat in the gas of combustion. The bulk of the remainder of the sensible heat in the gases leaving the boiler was extracted in a feed-water heater of similar design to the boiler; the gases being drawn through the tubes of the plant by means of a suction fan working at high water gauge.

RATE OF EVAPORATION.

Not only was the efficiency of these plants higher than anything ever attained in previous boiler practice, but the rate of evaporation on normal load was over 20 lbs. of water per hour per square foot of heating surface. In fact, during a series of tests on one of these earlier boilers installed in South London this latter figure was run up to and maintained at 35 lbs. per square foot of heating surface—and yet during these tests the official reports describe the steam as being practically dry, the moisture being too little for determination.

MODIFICATIONS.

It was soon realized, however, that for simplicity of control, and to allow for wider application of this type of boiler to the realm of industry, certain features needed modification. Among the points which required attention were:

(*a*) The use of an explosive mixture in the burners, which allowed back-firing to occur unless care was taken every time the burners were adjusted.

(*b*) The use of granular refractory packing, which occasionally gave trouble by breaking down owing to intense local temperatures developed by lack of free radiation from groups of particles.

(*c*) The use of densely packed tubes and restricted areas in the gas passages, which meant very high suctions.

Nevertheless, the results obtained in the early plants definitely established the possibilities of gas firing in separate tubes; and the general principles of these earlier inventions were developed by a London Consulting Engineer (Mr. P. St. G. Kirke), who was interested in the earlier work. Development followed along practical lines, by systematically eliminating the defects enumerated above.

THE SPENCER-BONECOURT BOILER.

The modern descendant of the Bonecourt boiler is now known as the Spencer-Bonecourt "Kirke" patent boiler, and is divided into two classes:

(*a*) The "K" type long-tube unit with unpacked tubes, operating on moderate induced draught, for outputs up to 36,000 lbs. of steam per hour per single drum boiler and 72,000 lbs. of steam per hour per multi-drum boiler. (A few sizes of natural-draught units are also constructed in the smaller sizes.)

(*b*) The "B" type short-tube unit with steel spiral cores, operating on natural draught, for small outputs up to 1500 lbs. of steam per hour.

The over-all thermal efficiency of these units, working on induced draught, is approximately 90 p.ct. With the natural draught units, a higher outlet temperature has to be allowed, and this brings the efficiency of the latter type of boiler down to approximately 85 p.ct. The high efficiency of these boilers is due to intimate molecular mixing of gas and air, and consequent perfect combustion with only a very small percentage of excess air, coupled with a design which transfers the heat of combustion from the hot gases to the water in the boiler in a highly efficient manner. At the same time, combustion takes place at high speed, and the consequent steam output per unit of heating surface is very high.

In dealing with the later boilers, the simplicity of the burners and of their calibration, together with the fact that back-firing is impossible, will be noted, also the arrangments for ensuring correct mixing at any load. Furthermore, the gradual elimination of the separate feed-water heater and its corrosion troubles will be observed, also the facilities for tube cleaning internally and externally—both highly important features when dealing with fire-tube boilers. In fact, the fire-tube boiler would never have been so completely overshadowed by the water-tube boiler during the last twenty years if these last two important details had not been let slip by the earlier fire-tube boiler designers. Compactness of plant, lack of brickwork for foundations, flues, settings and chimney, and small floor space occupied, also stand out as salient features. The low cost of installation is obvious.

THE COMMERCIAL ASPECT.

So much for the technical side. Now for the commercial side—*i.e.*, the cost of steam production by gas firing. Blast-furnace gas, coke-oven gas, the surplus gases of some of Britain's greatest industries, are outside the gas engineer's sphere (unless he is a bulk buyer of surplus coke-oven gas), but town gas is his main product, water gas a product of by no means negligible cost, and producer gas a means to an end also representing a fair cost figure. In other words, these three gases are all manufactured goods, and have to be delivered at the boiler at a certain price—whether at works cost or total gross cost including share of distribution charges, depends on circumstances.

Town gas is obviously too expensive a fuel for heavy steam generation duties, but for lighter services its use in conjunction with an 85 p.ct. to 90 p.ct. efficiency boiler unit is an excellent commercial proposition. Taking a typical case where 475 B.Th.U. gas sells at 3s. 6d. per 1000 c.ft., and coal of 12,000 B.Th.U. per lb. costs 35s. per ton delivered to the boilers. The maximum steam output required is at the rate of 1000 lbs. per hour; but the average load throughout the week (a 16-hour day is worked) is only 250 lbs. per hour. On such a varying load, the proposition of a coal-fired vertical boiler works out at only 50 p.ct. efficiency, whereas the gas-fired boiler averages 85 p.ct. Gas costs over 96 hours useful steaming, plus half-an-hour on Monday mornings and a quarter-of-an-hour on other mornings—*i.e.*, when the water is warm—work out at a little over £9 per week; and as the boiler is entirely automatic, operating costs stop at this. The coal-fired boiler displaced by the gas-fired unit working 96 useful hours *plus* a further eight for non-productive firing (getting up steam in mornings and allowing for banking coal at night) worked out at a fuel cost of approximately £3 10s. per week, to which has to be added two stokers (one per shift) costing £6 12s. per week—*i.e.*, the gas-fired boiler saved over £1 per week, apart from its greater convenience, cleanliness, and steady head of steam at constant pressure throughout the

Schedule A.—*Some Typical Test Figures Obtained on Various Sizes of Spencer-Bonecourt "Kirke" Patent Gas-Fired Boilers.*

—	Plant A.	Plant B.	Plant C.	Plant D.	Plant E.
Maker's size number of boiler	3.B.	5.K.	9.K.	14.K.	..
Over-all dimensions	2 ft. 3 in. by 6 ft.	3 ft. 6 in. by 11 ft. 6 in.	4½ ft. by 17 ft.	7 ft. by 17 ft.	..
Mean draught	Natural, $\frac{3}{10}$ in.	Induced, 1 in.	Induced, 1 in.	Induced, $1\frac{7}{10}$ in.	8 in.
Average pressure through test	10 lbs. per sq. in.	120 lbs. per sq. in.	89 lbs. per sq. in.	90 lbs. per sq. in.	..
Fuel	Town gas of 450 B.Th.U.	Producer gas of 130 B.Th.U.	Water gas of 287 B.Th.U.	Producer gas of 135 B.Th.U.	Town gas of 480 B.Th.U.
Duration of test	24 hours	6 hours	3 hours	17½ hours	2 hours
Average hourly evaporation	397 lbs. from and at 212° Fahr.	2320 lbs. from and at 212° Fahr.	2528 lbs. from and at 212° Fahr.	10,070 lbs. from and at 212° Fahr.	104 lbs. from and at 212° Fahr.
Average hourly gas consumption, corrected to N.T.P.	990 c.ft.	19,100 c.ft.	9337 c.ft.	78,500 c.ft.	230 c.ft.
Thermal efficiency	86 p.ct.	90 p.ct.	91 p.ct.	92 p.ct.	91 p.ct.
Whether lagged or not	Yes	Yes	Yes	Yes	No
Location of boiler	In kitchen of large restaurant for steam cookers	At gas-works	At gas-works	At industrial establishment	In experimental laboratory

working period, which latter item meant a good deal to the operatives using the steam for process work.

Town Gas for Small Services.

In cases where the steaming is more intermittent, and, again, where there is an eight-hour day only, the saving due to gas-firing is very much greater. For these small services, and for work in isolated situations, these small town-gas fired units are a proposition which had appealed to an immense variety of trades and industries. The small "B" class units were primarily intended to meet this class of work, and incidentally are of great interest to the gas sales department, whose object is to promote the sale of gas for industrial purposes and secure good "bulk" consumers. For the works engineer, these small boilers are a ready solution where small quantities of steam—often an intermittent demand—are required at some distance from the main boilers. The heavy condensation losses due to long steam ranges in such cases are then, of course, eliminated. The exact dividing line as to where town gas becomes too expensive is, of course, different for different specific cases; and each proposition must be thrashed out on its own merits. The cheaper the gas can be supplied, the greater the range for its use. The general remarks applying to town gas as a fuel also refer to water gas, with the exception that the range of economic evaporations is considerably increased, owing to the cheaper cost of the gas on a therm basis.

Producer Gas for Boiler-Firing.

I should like to enlarge on the possibilities of producer gas for boiler-firing, as this section of the subject is not only of great interest, but is also one in which I myself believe great developments are possible in the very near future. Apart from the fact that certain fuels work far better when gasified than when burnt in the raw state, a healthy bye-product market allows producer gas of good quality to be made at a very low cost, in spite of the greater capital charges on a recovery-producer *plus* gas-fired boiler unit, as compared with a direct-fired unit. At the same time more steam is produced per pound of coal than in (say) Lancashire boilers, owing to the high efficiency of the combination of producer and boiler.

Taking some typical figures from the latest Power Gas Corporation type of low-temperature recovery producer, one ton of 12,500 B.Th.U. slack gives approximately 118,000 c.ft. of 175 to 180 B.Th.U. gas, 16 gallons of tar, and 80 lbs. of sulphate. The sale of the two bye-products enables the gas to be produced at a very low figure, and yet cover all charges adequately.

The "K" type of boiler for use with this kind of gaseous fuel, is well worth the very serious attention of any gas engineer who has to provide for heavy steam requirements in a large works.

WASTE-HEAT RECOVERY.

I now come to the second part of my programme—the subject of waste-heat recovery, The use of waste gases for steam generation is nearly as old as the steam boiler itself; but it is remarkable what little real progress has been made in this direction until quite recently. Probably the cheapness of our primary fuel—coal—in pre-war days, made us much too casual to bother very much about the efficient utilization of hot gases which had already done certain work, such as heating furnaces, retorts, &c. As often as not, the hot gases were rejected to the atmosphere, or else waste-heat recovery was attempted in a very half-hearted manner with an adapted boiler—with the net result that in many cases the objections to the plant often outweighed the advantages. And yet—criminal though it seems in these days of dear fuel, when everybody is trying to cut costs of production—one can travel from one end of this country to the other and see plant after plant where a battery of coal-fired boilers is located almost alongside a set of furnaces, retorts, &c., and where there is sufficient heat available in the waste gases to generate a big proportion, if not all, of the steam required in the works in question. This is rather a sweeping statement; but it is true.

The Waste-Heat Boiler.

The essence of efficient and effective waste-heat recovery is that the problem of the waste-heat boiler is entirely different from the ordinary solid fuel-fired boiler; and it is the adaptation of the latter type of boiler without alteration to waste-heat recovery schemes which has done much in the past to sour engineers against the whole subject. Plants so installed have generally only been partially successful; and all sorts of difficulties and unfortunate experiences have resulted — for the fundamental reason that we, as engineers, had tackled the whole problem from the wrong angle. It is true that when gases available as waste-heat nearly approach the conditions of temperature, &c., which maintain in an ordinary coal-fired grate, the standard coal-fired boiler is an excellent proposition as a waste-heat recovery unit; but in these days of regenerative furnaces the big percentage of the waste-heat of industry has an inital temperature very much below that of the coal-fired grate.

Four Main Considerations.

I want to put this subject before you briefly from four different standpoints:

(*a*) Questions of draught conditions.
(*b*) Heating surface conditions.
(*c*) Circulation problems.
(*d*) Cleaning problems.

First, to consider draught with the earlier types of waste-heat boiler it was usual to minimize the frictional resistance of the gases passing through the boiler by providing a large flow-area, in order to interfere as little as possible with the draught leaving the furnace. Obviously the extraction of heat from the gases upset existing chimney draught conditions; and the scheme outlined above, plus the addition of a further length of chimney, was the early way of compensating for this loss, in order not to upset the furnace. This practice, however, at once limited the range of the application of waste-heat boilers, and practically excluded their use on low-grade gases, as the limit of boiler size to give the requisite free area for gas flow, coupled with excessive chimney conditions, largely ruled out waste-heat boilers, from the double points of view of inability to locate the large boiler in the available space, and the capital cost of the complete installation, apart from the low efficiency of such a boiler, owing to its huge radiation surface and to the small temperature drop allowable through the boiler. Hence, with a few exceptions, induced draught must be looked upon as essential to really efficient waste-heat recovery plant on the ordinary run of waste industrial gases. The keeping of the power required for supplying this induced draught down to reasonable limits, will be discussed later.

Disposition of Heating Surface.

Coming to the second part, the importance of the question of disposition of heating surface in waste-heat boilers seems to be very little appreciated among the majority of steam engineers; and yet it is really the key of the whole position. The fact that this has until recently been so completely neglected in considerations relating to waste-heat boilers is due to the old trouble of the adapted boiler. Fundamentally, the direct coal-fired boiler was designed principally to absorb heat units from high-temperature furnace gases, and boiler and furnace are proportioned in order to get the very best combined results. High-temperature gases possess high radiant heating qualities, and any good fuel-fired boiler is designed to make the most of this radiant heat. The remaining heat from the furnace gases—which passes to the heating surface by convection—takes a minor part in the scheme—in fact, no well-laid-out fuel-fired boiler plant is considered complete without economizers, which are first and foremost an addition to help out the boiler in absorbing sensible heat from the gases by convection, precedence in the boiler itself being given to the radiant heat evolved from the fire.

With a furnace temperature of 2700° Fahr., such as obtains on a first-class water-tube boiler with mechanical stoker, approximately 66 p.ct. of the heat absorbed by the plant is due to radiation. Consider a similar type of boiler now fired by waste heat at 1000° Fahr. from (say) a battery of vertical retort settings. Stefan's law states that the radiation absorption varies as the fourth power of the absolute temperature of the radiating medium. Hence, in the case of this boiler working as a waste-heat boiler, the percentage of heat absorbed by radiation is only

SCHEDULE B.—*Some Typical Test Figures obtained by Spencer-Bonecourt "Kirke" Patent Waste Heat Boilers.*

—	Plant A.	Plant B.	Plant C.	Plant D.	Plant E.
Maker's size number of boiler	10 K/15½	12 K/15½	10 K/15½	2—14 K/17	10 K/17
Over-all dimensions	5 ft. by 18 ft.	6 ft. by 18½ ft.	5 ft. by 18 ft.	7 ft. by 21 ft. twin drum	5 ft. by 19½ ft.
Mean draught through boiler	$1\frac{8}{10}$ in.	$1\frac{8}{10}$ in.	$1\frac{8}{10}$ in.	1 in.	$2\frac{1}{10}$ in.
Average pressure through test	114 lbs. per sq. in.	62 lbs. per sq. in.	100 lbs. per sq. in.	90 lbs. per sq. in.	105 lbs. per sq. in.
Installed on	Vertical retort settings	Vertical retort setting	Vertical retort setting	Regenerative furnace	Horizontal retort setting
Duration of test	10 hours	4 hours	8 hours	24 hours	4½ hours
Average hourly evaporation	2542 lbs. from and at 212° Fahr.	5830 lbs. from and at 212° Fahr.	1466 lbs. from and at 212° Fahr.	6720 lbs. from and at 212° Fahr.	1610 lbs. from and at 212° Fahr.
Inlet temperature of waste gases	660° C. 593° C. after superheater	850° C.	383° C.	525° C.	510° C. before superheater.
Outlet temperature of products leaving boiler	216° C.	219° C.	192° C.	190° C.	206° C.
Tube efficiency	90 p.ct.	90·8 p.ct.	89·6 p.ct.	94·5 p.ct.	89 p.ct.
Whether lagged or not	Yes	Yes	No	Yes	No
Amount of superheat	135° Fahr.	..	..	..	61° Fahr.
Percentage of power developed by fan (assuming 15 lbs. of steam 212° Fahr. per B.H.P. hour)	2·53 p.ct.	2·5 p.ct.	Not measured	1·75 p.ct. boiler 2·85 p.ct. furnace	3·12 p.ct. boiler 2·96 p.ct. settings

3 p.ct. of its total absorption as a waste-heat boiler. Suppose that, in the water-tube boiler under consideration, the maximum evaporation per square foot of heating surface in a particular section of tube immediately over the fire is 60 lbs. from and at 212° Fahr. per square foot per hour, this being due to radiant absorption, then the evaporation in the corresponding section of tube in an exactly similar boiler working on waste gases will be only:

$$75 \times \frac{3}{66} = 3 \text{ lbs. per square foot from and at } 212° \text{ Fahr.}$$

HEAT TRANSMISSION.

Again, in either case, the heat transmitted to the water by convection is approximately the product of transfer rate (R) heating surface and average temperature range. The gases leaving the radiant zone in the fuel-fired unit will be approximately at 1200° Fahr., while 1000° Fahr., which is the temperature we are assuming for purposes of comparison as the inlet temperature of the waste-heat boiler, may be taken approximately as correct for the inlet temperature to the true convection zone on the second boiler.

Hence, if in either case the gases be cooled down to an outlet temperature leaving the economizer, of 300° Fahr., the average temperature difference through this zone will be

$$\frac{1200 - 300}{2} \text{ and } \frac{1000 - 300}{2}$$

i.e., 450° Fahr. and 350° Fahr. respectively.

Assuming both boilers under consideration to be evaporating 10,000 lbs. of steam from and at 212° Fahr. per hour, then

(*a*) The fuel-fired boiler is evaporating 6600 lbs. by radiant heat and 3400 lbs. by convection.

(*b*) The waste-heat boiler is evaporating 300 lbs. by radiant heat and 9700 lbs. by convection.

To obtain the transfer rates for convection in each case we therefore get, assuming equal evaporations,

$$R_f \times HS \times 450 = 3400$$
$$R_w \times HS \times 350 = 9700$$

$$\text{therefore } R_{F/R_W} = \frac{3400}{9700} \times \frac{350}{450} = 2·73$$

Hence, for each boiler unit to develop its convection output as scheduled above, the waste heat unit must have a transfer rate by convection of nearly three times that of the coal-fired unit. This transfer rate is a product of the velocity, other factors remaining constant. Hence the obvious necessity for the waste gases being forced to sweep over the heating surfaces at a high velocity to obtain this high transfer rate. The alternative is to design the boiler on a coal-fired basis and treble the heating surface—but even this would not in practice give the required results, as the very much larger boiler involved would increase the percentage loss of heat due to radiation from the unit and the settings.

THE EFFECT OF INCREASED VELOCITY.

The obvious way of increasing the velocity of the gases over the heating surface is to make use of the induced draught fan unit to a further degree than merely to replace the equivalent chimney draught due to the lower available gas exit temperature from the waste-heat boiler. But the difficulty now arises that if this increased velocity is put on the waste gases, the evaporation will only increase proportionately with the velocity, provided conditions of temperature drop remain the same as before. It is obvious that unless the heating surface is suitably arranged to meet these higher draught conditions, the tendency is for the outlet temperature of the waste gases leaving the boiler to rise, thereby largely counteracting the beneficial effect of speeding-up the gases. In many instances this has been partially overcome by the addition of very large economizers to the boilers; but further difficulties now arise, for if the economizer is not to make steam, its output becomes too great for the waste-heat boiler. To suit the boiler, it is obvious that the relation between the heating surface of the economizer and the heating surface of the boiler should be much lower in a waste-heat boiler than in a coal-fired unit.

On the other hand, it is obvious that if a boiler be designed with its heating surface suitably disposed to deal with the high-velocity waste gases as a normal working condition, and at the same time to reduce these outlet gases to a temperature which is within a few degrees of the steam temperature in the boiler, then this essentially waste-heat recovery unit would be a far better proposition than the makeshift arrangement of the coal-fired unit.

DRAUGHT.

This brings us back again to the question of draught. Induced draught has now not only to be used for chimney effect, but also for speeding-up the gases as they pass over the heating surface of the boiler, and we arrive at the important fact that, unless this problem of draught be tackled very carefully, a large proportion of the power developed by the boiler will be used up for the fan drive. The power used by the fan drive is largely used in accelerating the gases; and if the gases can proceed through the boiler in a straight path, it is obvious that there will only be one acceleration to be accounted for. If, on the other hand, the gases are led through the boiler in (say) a zig-zag path, the frequent changes of velocity all add to the fan power required. This is one of the main reasons why, in the speaker's opinion, many waste-heat boilers (more particularly those based on standard coal-fired designs) absorb too great a proportion of the total power developed by the boiler, as fan power; and yet, in order to obtain effective heat transmission, the zig-zag path is absolutely essential in this type of unit.

CIRCULATION.

Coming to the consideration of point (c)—*i.e.*, circulation problems—it will readily be appreciated that a boiler which has a positive and vigorous circulation when dealing with gases from 1400° C. down to 300° C. will often behave very differently with gases entering at 500° C. and leaving at 200° C.; and it frequently happens that a very good direct-fired boiler can, for this particular reason alone, give unfavourable results as a waste-heat unit. Furthermore, as the intensity of circulation is reduced (in some cases I have known circulation to become reversed) a boiler which normally sweeps away sediment as it is deposited on the hottest tubes, often gives abnormal trouble through incrustation when in use as a waste-heat boiler.

IMPURITIES IN THE GASES.

Turning to point (*d*), the gases dealt with from industrial furnaces often contain a heavy percentage of impurities. Dust, provided it travels in straight lines, will be carried through the boiler; but when the path of the gases is reversed, a considerable proportion of the dust in suspension in the gases becomes deposited immediately below the point of no velocity in the gas path. This can generally be removed by a suitable cleaning device such as blower jets, &c.; but tarry deposits give far more trouble, as they adhere to the heating surface irrespective of gas velocity and direction, and must be removed mechanically. Hence, for a waste-heat boiler to be efficient over long periods of running, adequate cleaning arrangements are essential.

Summing up, the ideal waste-heat boiler, apart from having its heating surface suitably disposed and arranged for high heat transference coupled with a low outlet temperature, must also be easy to clean both on the water and gas sides of the heating surface—and must be a suitable subject for induced draught—*i.e.*, all possible sources of leakage of cold air into the hot gases must be removed. At the same time, the unit must not be bulky, as it has to be suitable for placing in the vicinity of its source of heat without in any way inconveniencing the working of same.

SPENCER-BONECOURT WASTE-HEAT BOILERS.

I will now describe some Spencer-Bonecourt "Kirke" patent

waste-heat boilers, together with brief descriptions of some typical gas-works installations.

This particular boiler has been evolved from two sources:

(*a*) By careful study of the principles underlying waste-heat recovery, as outlined above.

(*b*) By applying the design of the gas-fired fire-tube type of boiler described in the first part of my lecture to meet the special conditions of waste-heat recovery.

It has taken some twelve years of research and experimental work to evolve these units, the design of which is primarily based on the actual behaviour of various gaseous mixtures resulting from combustion products, between different ranges of temperature and at different specific heats, when travelling at various velocities through tubes immersed in water. The complete correlation of this data is the basis of the design of these units.

Outstanding Features.

I will briefly sum up the outstanding features of this particular boiler:

(*a*) The boiler is a fire-tube unit having its heating surface so disposed and so correlated with the requisite draught conditions as to give a very high heat transference coupled with a tube efficiency of approximately 90 p.ct.—the draught drop through the tubes themselves being generally from 1 in. water gauge upwards, according to the nature of the problem.

(*b*) The hot products of combustion travel through the tubes of the boiler in an absolutely straight path, and thence change their velocity gradually as the temperature diminishes. They do not change their direction through the boiler; hence the power required by the fan is much less than with any other type of boiler working on induced draught.

(*c*) The boiler has adequate cleaning facilities for dealing with dirty gases without interfering with the running of the plant, and is suitably constructed and designed for dealing with impure feed waters without interfering with the transmission efficiency of the fire-tubes.

(*d*) There is a complete absence of brickwork or sheet metal casings for any sections carrying heavy induced draught, hence rendering leakage of cold air to the boiler heating surface impossible. This waste-heat boiler is a self-contained unit of small dimensions for its capacity, and is particularly suited for propositions where space is limited.

(*e*) In cases where the supply of waste gases is variable, but where the demand for steam is practically constant, this type of boiler is particularly suitable, as it gives a large reserve of steam space.

(*f*) As the waste gases leaving the boiler are only a few degrees higher than the steam temperature itself, an economizer is not at all essential, and is, in fact, generally eliminated.

The absence of an economizer cuts out the corrosion bugbear so common on waste-heat recovery plants which need this addition to the plant for efficient working; and corrosion of fan parts is prevented owing to the safe temperature at which the fan works.

Special care is taken to ensure that the draught in the retorts themselves cannot suffer in any way owing to the addition of waste-heat recovery plant to the scheme; and precautions are taken to ensure continuity of draught over long periods and at the same time to allow the retort-house fireman positive control over same. Feed water regulators, and generally low-water alarms, are fitted to practically all the installations.

Waste-Heat Recovery from Internal-Combustion Engines.

Lastly, a few words on waste-heat recovery from internal-combustion engine exhausts. The discharge temperature of a gas-engine working on full load runs from 450° C. to 500° C.; and the exhaust gas contains some 40 p.ct. of the total energy supplied to the engine as heat units. The use of waste-heat boilers on large gas-engines has been practised for many years; but the corrosion problem has always been a factor which somewhat crippled the development of waste-heat recovery on these lines.

Corrosion.

Corrosion in this class of boiler is due to two causes. Firstly, tube corrosion is due to the action of acid gases during the period when the steam is being raised. Owing to the high rate of heat transmission from the waste gases to the water in the Spencer-Bonecourt type of boiler, this "sweating" period is reduced to the minimum. The second cause of corrosion is due to reduction of the outlet temperature below the critical temperature of corrosion, whence acid gases attack the rivets and the tube plate at the outlet end of the boiler. In waste-heat boilers without economizers, the outlet temperature of the waste gases must obviously be higher than the steam temperature. Hence this difficulty is eliminated.

The standard types of boiler for waste-heat recovery on internal-combustion engines are all similar in general design to the "B" class boiler—*i.e.*, they are fitted with special spiral cores in the tubes, which increase the rate of transmission of heat and incidentally decrease the size and cost of the boiler for any given size of engine.

I am adding in a schedule form some figures taken from typical tests runs by (*a*) gas-fired boilers, and (*b*) waste-heat boilers. All these tests were made on running plants under ordinary service conditions, the one exception being the test on plant "E" in Schedule "A," which was run on one of our experimental units (a small boiler used for determining outputs per standard tube on various types of combustible gases). I purposely added this particular test to compare it with the others, and show how laboratory results are easily obtained—and indeed exceeded—in practice.

A feature of the lecture was the large number of lantern slides by which it was accompanied. The first series of these showed the development of the Spencer-Bonecourt gas-fired boiler from the early stages; and the second series, a number of gas-fired and waste-heat boiler installations.

Discussion.

The President (Mr. D. Cleaves Cross, Lea Bridge) remarked that the lecture had been most interesting, and everyone must be desirous of having figures of cost, &c. First there was the question of the capital cost of a Lancashire boiler and a Spencer-Bonecourt boiler using coal gas. The lecturer had stated that town gas was not economical over a size of (say) 1500 lbs. per hour. This was only 150 gallons of water, which came down to rather a small boiler—not of the size they were used to on gas-works. Anything from 500 to 1000 gallons of water an hour was more what they were accustomed to. Working out some of the figures, he had seen that if they could get a gas-fired boiler of 1000 gallons per hour capacity, the cost for gas would be from 60s. to 83s. This was calculated on the basis of a highly efficient boiler, working under good conditions. At his works they used breeze costing about 12s. 6d. per ton; and an ordinary test taken a few months ago on a Lancashire boiler showed that with 1 lb. of breeze they evaporated 6 lbs. of water, so that with a ton of breeze they evaporated something like 12,000 lbs. of water. This meant that for 1000 gallons of water, to evaporate which with the gas-fired boiler would cost from 60s. to 83s., the cost in the case of the breeze-fired boiler came down to 10s. to 12s. It seemed, therefore, that, for a big boiler, town gas was not a proposition one could think of; it was only for the smaller-sized boilers one could use gas. In the examples given by the lecturer, it was shown that the whole of the saving as between the two boilers was under the heading of labour, for which Major Gregson had charged nothing in the case of the gas-fired boiler. He thought this was wrong, as there must be some charge for labour in the latter case. It was impossible for such a boiler, started-up at the beginning of a week, to function automatically without attention. The whole saving in the week was £1; and he did not think it would be too much to put the whole of this against labour. As to waste-heat utilization, this must interest nearly everyone present, because it appealed strongly to gas engineers. While engineers were clamouring for it, their directors were apt to be against them, on account of the capital outlay involved. Boards were turning-down the question at many works on this account. Taking a water-gas plant working (say) only three months intermittently, the capital outlay on a waste-heat boiler might be from £5000 to £6000—very much more than a Lancashire boiler, which would work all the year round. Where he thought they were going to score in connection with vertical retorts was by adopting the ideal arrangement which the lecturer had explained.

Mr. S. B. Chandler (Tottenham) said they must appreciate greatly the information which had been placed before them that evening. The President had spoken particularly from the works point of view. Looking at the matter from the distribution standpoint, one must have been much impressed by the high thermal efficiency of the Spencer-Bonecourt boiler. An over-all thermal efficiency of 85 p.ct. in practice was a very high figure indeed. The question was important from his particular point of view, inasmuch as it represented a further outlet for the consumption of gas. He had not had a great deal of experience with the Spencer-Bonecourt boiler; but he was convinced that without doubt many of the claims made by the lecturer were substantiated in practice. He remembered being called in some time ago by a well-known American engineer to discuss the question of a small amount of steam required for experimental purposes; and as the result, a Spencer-Bonecourt boiler was installed. It took up a very small space; and its weight was little. It was fixed on the first floor of a factory; and his latest information was that it functioned extremely well. Another case was a laundry, where trouble had been experienced both in regard to coke storage and labour. Of course, a large amount of steam was needed, and he advised a "K" boiler. This was working quite satisfactorily, and was saving labour; one of the laundry attendants looking after it occasionally. With the lowering of the price of gas, there was a big future before the Spencer-Bonecourt boiler for small units. With regard to a waste-heat boiler connected to a gas-engine, the lecturer referred to large engines. What did he consider to be the minimum horse-power at which it would be economical to fix a waste-heat boiler?

Mr. W. T. Kenshole (Lea Bridge) asked the approximate weight of the waste-heat boiler usually fitted to a Glover-West setting.

Major Gregson, in reply, said that, with town gas at 9d. per therm, compared with coke breeze, there could be no comparison in cost except for small units. By cheapening the supply of gas for bulk consumption, however, the range of boilers which could economically be operated on town gas would obviously be greatly increased; and it would appear to be a proposition well worth the consideration of gas companies. Obtaining consumers to take gas in bulk was the way to increase gas sales and, at the same time, decrease overhead charges. In quite a number of places abroad, his Company had been able to put in much larger town-gas fired boilers than obtained in this country, because of the special rates at which gas was supplied. He agreed that coke breeze was, next to waste heat, the cheapest fuel the gas manager could use for the ordinary run of works steam requirements; and he did not want his audience to go away with the idea that he was in any way prejudiced against the use of coke breeze. In fact, he was closely interested in a boiler which was specially designed for the use of this particular fuel; but he had refrained from touching on this subject during the course of the evening, as he was keeping his remarks solely within the bounds of the title of the lecture. Re-

garding Mr. Cross's remarks, it often happened that labour was the only real saving on small gas-fired boiler plants; but they frequently met with cases in which £5 to £6 per week was saved under this head alone. The small-sized "B" class units he had described were really self-acting; and he had known them go on for weeks without any attention. After all, the crux of the situation was in having thoroughly reliable and positive controls. In these circumstances, he did not see how one could fairly claim to place £1 per week against labour costs for a gas-fired boiler, when the maximum requirements would only be periodic lighting up, and shutting off the gas at the end of the period. The cost of waste-heat recovery plant depended, of course, upon the type of retort installation; but in any case, in ordinary circumstances, the waste-heat recovery plant ought to recoup its first cost within some eighteen months of its installation on fuel saving alone—*i.e.*, if the plant cost £3000, it should save fuel at the rate of £2000 a year. In order to do this, it was obviously essential to have a proper boiler for the job, as it was not only a question of high efficiency, but also of a suitably designed plant to keep down original cost in the first instance. As to Mr. Chandler's remarks on gas-engine exhausts, the smallest standard-size boiler was for an 80 B.H.P. engine. Below this it was generally economical to recover waste heat for water-heating purposes only, as the capital cost of the very small boilers was out of proportion with the saving effected. Regarding the weight of vertical boilers of the type described for Glover-West settings—*i.e.*, the alternative scheme where induced-draught units were not used—these separate boilers weighed approximately 47 cwt., with a further 11 cwt. of water.

Mr. W. GROGONO (Gas Light and Coke Company), proposing a hearty vote of thanks to the lecturer, said he had told them all about waste-heat boilers; but he had not explained how they could save the heat when quenching their coke.

Mr. W. L. WESTBROOK (North Middlesex Gas Company) seconded the vote, which was carried with applause.

Major GREGSON, responding, said that coke quenching was outside his sphere of activities; but he had seen a plant on the Continent recently which appeared to have dealt with this question thoroughly; the plant being arranged in conjunction with a waste-heat boiler.

Unprofitable Gas Consumers.

The Grand Rapids Gas Light Company have recently prepared a report on the gas-rate question, at the instance of the Michigan Public Utilities, to ascertain the form that rates should take to equalize the charges to all consumers. It seems from this report that the Company have on their books a large group of consumers whose accounts do not even pay operating expenses, and also another big body of users whose accounts, while meeting operating expenses, fall short of furnishing a proper profit. This state of affairs, it is said, is the result of the long-established, but economically faulty, flat or uniform rate per 1000 c.ft. The profitable consumers have thus to pay a higher rate than they should do, in order to make up the loss on the other groups. On the estimated operating expenses for 1923, each consumer causes an outlay of $1·24 per month before he is supplied with any gas at all. At the present rate, the monthly bill for 900 c.ft. is $1·17, and that for 1000 c.ft. is $1·30. Thus such consumers do not even pay the expense they cause before they are supplied with any gas at all, and consequently obtain such gas as they use for nothing. For the year ended Oct. 31 last, there was a total of 62,216 of these bills, or an average of 5185 bills per month—about 13·66 p.ct. of all the consumers. An analysis shows that the less fortunate members of the community in Grand Rapids are not the very small users of gas. The really small consumers are composed largely of business concerns, professional men, and homes and apartments of the middle class, where there are only two or three in the family, where there are no children, or the children are grown up and have left home, or where the family go out for meals or buy partially prepared food, and very little cooking is done; and also the homes of those more fortunately situated, who spend several months of the year away from home, with the house closed, and there is consequently little or no consumption of gas. These people can afford to pay for any burden they put upon the gas company.

Gaseous Combustion at High Pressures.—Next Friday evening (May 11), at 9 o'clock, Dr. W. A. Bone, F.R.S., M.R.I., will lecture at the Royal Institution, Albemarle Street, W., on "Gaseous Combustion at High Pressures," with new experiments.

The "C.P." Meter Diaphragm.—A large number of gas engineers visiting Brighton on the 26th ult. availed themselves of the invitation extended by Messrs. Joymanco (Brighton), Ltd., to a demonstration of their "C.P." meter diaphragm. Very great interest was shown by those present, and it was felt that the invention would prove to be both welcome and valuable in connection with diaphragms of dry gas-meters. The visitors afterwards joined the Directors at dinner at the Royal York Hotel.

The "Birmingham Medal."—The following appears in the May issue of the South Metropolitan Gas Company's "Co-Partnership Journal": We congratulate Mr. W. Doig Gibb (sometime Chief Engineer to our Company) on being awarded the "Birmingham Medal" of the Institution of Gas Engineers. This medal is a coveted distinction in the gas industry. It was founded about forty years ago, when Mr. Charles Hunt was President of the Gas Institute; and the first award was to the late Sir George Livesey. Subsequent awards have been made to Sir William Siemens, F.R.S., Mr. Charles Hunt (the originator of the medal), Dr. Thomas Newbigging, Dr. Carl Auer von Welsbach, Dr. C. W. Perkin, and others.

THE PLASTIC STATE OF COAL.

By G. E. FOXWELL, M.Sc., A.Inst.P.

[Extracts from a Paper read before the Coke-Oven Managers' Association at Sheffield, on April 27.]

When a South Yorkshire coal is heated at the rate of 1° C. per minute, the sequence of events is roughly as follows:

1. Up to 200° C. occluded gases are expelled, but no decomposition occurs.
2. Just above 200° C. decomposition commences; and water, together with small amounts of CO and CO_2, is evolved.
3. Up to 300° C. nothing appreciable is distilled; but a faster evolution commences.
4. At a temperature of about 370° C. the coal commences to fuse—*i.e.*, it enters the plastic state. This continues till about 480° C.

The amount of gas evolved during the plastic stage is not a high proportion of the total. Though the extent of decomposition is only small, the structural changes are most important. It is well known that coal can be resolved into three classes of compounds by the action of solvents. Owing to our ignorance of the character of these bodies we designate them α, β, and γ compounds. Of these the γ compounds alone fuse, and they alone yield a bright puffy coke. α and β compounds may yield a coherent coke; but it is always flat and black. It appears that during the plastic state the γ compounds become a maximum, but immediately after they fall to a very low figure, and then to zero. I should say that if the plastic state continues to 480° C., at 400° to 430° C. the γ compounds are a maximum; and then they decrease slowly until, when about 5 p.ct. is present, plasticity ceases. While in the plastic state, the coal is semi-molten. Just before fusion commences, the coal consists of a mass of solid particles with a relatively large volume of air-spaces between the component granules. In an actual case, the amount of air-space in an uncompressed charge was found to be 42 p.ct.

The generally accepted theory of the formation of coke is as follows: When fusion commences, the fused portions of the coal flow into the air-spaces, and in a short time the whole of the coal consists of a viscous fluid. As the temperature rises, this fluid thickens and finally solidifies. Throughout this period, gas is evolved from the coal, and this blows the plastic mass into a froth. The froth bubbles soon burst and collapse while the coal is fluid, but as the fluid thickens, the bubbles persist, and when solidification occurs at 480° C., we have the larger features of the well-known cell structures of coke. The smaller cells are added a little later, as some measure of plasticity persists up to, say, 550° C.

It appears that there is a force at work which hitherto seems to have been neglected in this connection—surface tension. As soon as a piece of coal becomes sufficiently fluid, or is covered by extruded fluid, surface tension forces it to take up a globular shape, and the same force will act in such a way as to prevent any alteration of this shape. Acting against this is the force of expansion in the globules, probably due to the escape of volatile matter, tending to make the particles cohere.

The first stage of coking is, therefore, the formation of these globules, either by extrusion or fusion (in the case of small particles). A good deal of gas is evolved during this stage. Then the particles cohere and form a network. The surface tension effects become lessened, and the coke formation, which is nearly complete in the interior of the bubbles, is carried on at the surfaces. The essence of the theory is that at no time is the whole mass a continuum of plastic material; and hence there is always a passage for gas in the plastic layer.

The fact that a powerful expansive force exists in the interior of a coking charge does not appear to have been realized hitherto. One of the consequences of this is that we have set up in the charge a thrust outwards to the oven wall. This will prevent the coke from leaving the wall till towards the end of the coking period. I believe this conclusion is generally supported by authorities on the subject. During coking, each individual particle of coal swells; and quite a moderate increase in the diameter of the coal particles will greatly increase the space they occupy. It may be argued that the fact that the coal was found to flow among the pieces of firebrick, is evidence against the theory of the plastic state which I have put forward; but I maintain that each particle behaves as an elastic ball. Owing to expansion, these balls are propelled forward, and will travel if there is a space for them to travel into. The globules will stick together to form a network, which will ultimately become coke.

We may ask ourselves: What is the cause of the plastic state? It is too soon as yet to give a definite and final answer to this question. I will, however, briefly recount an observation which leads to what I believe to be a plausible theory. If the South Yorkshire coal referred to is separated into α, β, and γ compounds, and the compounds thus separated are mixed, you will agree that we retain the composition, but not the structure, of the original coal. If the original coal and the mixture thus formed are separately and rapidly coked in a crucible, each yields a button of good coke; the buttons being indistinguishable. But when a measurement of plasticity is made by slow heating in my apparatus, the α, β, and γ mixture shows no sign of plasticity whatever, and the coke obtained is quite powdery. In the original coal, the α, β

and γ compounds are inextricably interwoven in the solid pieces of coal; thus forming the structure of the coal. In the mixture, the three bodies exist as separate discreet particles. When this mixture is coked, the swelling and rounding will only occur in the γ particles. Hence I believe that plasticity is due to the structural arrangement of the three classes of compounds in the lumps of coal. It is not merely due to the melting of the γ compounds, for these melt at about 120° C. in the coal I am referring to, but it is due to the manner of their extrusion.

Testing Coke by Abrasion.

Dr. A. Schmolke, in a recent lecture before a section of the German Coke Committee, outlined a method of testing coke by abrasion, says the "Iron and Coal Trades Review," for which he claimed certain advantages over the usual procedure. In this, a grinding machine is used; the test-piece of coke, in the form of a prism, being clamped fast between two flat bars on a knife-edge fulcrum. In order to prevent the coke turning with the emery wheel, recesses are cut in the two clamping bars, which are held together by screws; the coke under test fitting into the recesses. In order to produce a well-defined constant pressure on the coke to be ground, a lever is fixed at right angles to the pendulum carrying the sample to be tested; the lever itself carrying a weight producing a pressure of 2·2 lbs. on the sample under test. To counterpoise the weight of the weighted lever, clamping device, coke, &c., a weight is suspended from a cord passing over a fixed pulley, and secured to the clamping device. The grinding wheel used is of coarse-grained emery, and the speed of rotation 2340 R.P.M. The centre of the coke sample under test is at a distance of about 3 in. from the centre of the emery wheel. The test-pieces are prepared by hand grinding on another machine, dried at 110° C., and then weighed. The time of grinding each sample is 15 seconds, after which the sample is weighed again, and the loss of weight due to grinding gives the abrasive strength of the coke. As the friction at constant pressure is independent of the area of the surfaces in contact, Dr. Schmolke has carried out abrasive tests on unprepared samples of coke also, and found the results to be in accordance with those obtained on specimens prepared by being ground into a prismatic form.

Wash-Oil Recovery from Blast-Furnace Gas.

A paper on "Comparative Methods of Debenzolizing Wash-Oil, and the Recovery of Wash Oil from Blast-Furnace Gas," was read by Mr. F. D. Whittaker before the Northern Section of the Coke Oven Managers' Association, at Durham. Dealing with the benzole plant in use at some Scottish works (with blast-furnace oil as the chief benzole solvent), the author said that in one case the benzolized oil entered the heat exchanger at a temperature of 77° Fahr. There, by absorbing the sensible heat of the outgoing vapours from the still, the temperature was raised to 167° Fahr.; and thus it entered the superheater, where it was subjected to the heat of indirect steam at 150 lbs. per sq. in., after which the oil entered the still at 248° Fahr. Open steam entered the bottom section of the still at 15 lbs. pressure, and passed through the descending oil; the oil denuded of its benzole flowing to the coolers. The benzole, water vapour, and benzole vapours from the superheater passed from the still to the heat exchanger, condenser, and separator. In the second instance—a comparatively low-temperature method—the course of the benzolized oil (termed charged creosote) and benzole vapours was the same as in the high-temperature process; but water from the steam or other source passed both ways—some with the benzole vapour, and the remainder with the debenzolized creosote. A heat exchanger was always part of the plant; and in some cases a superheater was also introduced. Benzolized oil entered the heat exchanger at a temperature of 62° Fahr.; and in its passage counter-current to the benzole vapour and steam, its temperature was raised to 86° Fahr. prior to entering the still. The freshly saturated creosote entered at the top of the column, and encountered the steam already containing large volumes of benzole vapour. In passing from section to section, being continuously subjected to the action of steam containing less and less benzole, it was gradually denuded, until, undergoing the final treatment with fresh steam, it left the apparatus entirely freed from its volatile benzole compounds. The benzole and water vapours, escaping from the top of the still at a temperature of 184° Fahr., were largely condensed in the heat exchanger, from which the condensate and remaining vapours flowed to the cooler and separator. The debenzolized oil containing water left the still at a temperature of 203° Fahr., and entered the separator—a rectangular vessel divided into a number of divisions by baffle-plates. The mixture of oil and water overflowed from one division to another till complete separation had been effected. The oil then overflowed into the cooler and to the tank.

London and Southern District Junior Gas Association.—The annual general business meeting of the Association takes place at the Westminster Technical Institute, on Friday evening of this week (May 11). New office bearers will be elected; and proposed alterations to the rules include one reducing the subscription from 12s. 6d. to 10s. a year.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Fuel-Gas or Coke.

Sir,—The recent partial lifting of the burdens due to war and strikes shows that we can for the gas industry face the future with greater confidence, and suggests further important considerations.

While always aiming at maintaining the repute of our product for quality, we formerly did not recognize that its value could be ascertained in a simpler, closer, and less risky manner than its mere illuminative tests furnished, though I think most of us were aware that the lighting value depended on its heating power. Nor did we anticipate that from outside authority would come a demand that the public need for direct fuel supply should be met by a mode of testing demonstrating this essential value in a direct heat test. But both these movements clearly arose from the enormous growth of the domestic and industrial uses of gas which marks the last twenty years of our existence, and has been so largely influenced by the "slot" facilities we have given. Though personally realized in an address of 1902 that "Fuel was our Flag," that view was contested when expressed, and almost ridiculed.

I am writing this because I discern a tendency at present to ignore the enormous fuel value of our coke, and, indeed, to deprecate its being saved from conversion into a form of service which destroys the greater part of its heat value—viz., water gas. This form of gas I have found for years past more costly than coal gas, value for value; and though in the war and strike periods I was driven to use existing plant, I have never relied upon its permanent aid for either economy of service or capital charge—the latter being considerable. I enter upon no other adverse consideration, though I am not insensible to it.

My object specially is to point out to your readers the difficulty and cost which must arise in its use from the very rapidly increasing adoption of petroleum oil for marine navigation, especially in the internal combustion engine, though it is largely displacing coal for raising steam in vessels, owing to its reduction of labour, cargo space for coal, and greater cleanliness and dispatch in fueling vessels. It is certain that shipowners can give prices for it above the present rates at which I can show it is uneconomical for gas making.

The sole remedy would be reducing the proportion of its use for gas, which would mean lowering the declared B.Th.U. value. But here, again, every month we find gas companies voluntarily raising the declarations they commenced with, and which their consumers were against. Clearly the position is one which must give pause to those relying on carburetted water gas.

The signs of the times point to the question of revision of the terms in many cases existing; and, as ever in the past, economy must prevail. The cheapest gas now being supplied in London is free, or nearly so, of water gas, because, although the capital charges are lower than for coal-gas plant, and conveniences for storage are useful, the fact is indisputable that true economy lies in the greatest possible reduction of its use. The prevention of extensions during the war has promoted the proportion of its use; but the economic advantage of capital cost and interest is temporary, ephemeral and unstable.

Now, on the coke question why are we so timorous of larger production, or rather of more saving use of it? The heat value is nearly equal to that of coal. It is a smokeless fuel, like our gas; and the "low-temperature carbonizing" advocates are strong on that quality. Can we not in our showrooms exhibit the Vernon Harcourt grate for using it, and also the capital central-heating water-boilers for its use? Messrs. Gill and Nicol have pointed out its great value for steam raising; and while writing, the demand for coke at home and abroad is rising.

The bugbear of coke stocks, and the facility of the water-gas plant for getting rid of it, appeal to the manager; but is it certain that if more pains were given to promote its uses it would not go? Anyway, the time is approaching when it will be found necessary to revert to the coal-gas process in much greater part, if not entirely.

Palace Chambers, S.W. 1, May 5, 1923. Hy. E. Jones.

"Broadberry" Automatic Controllers at Walthamstow.—Some five years ago, the Walthamstow Urban District Council had the whole of their street lamps fitted with "Broadberry" automatic controllers (supplied by the Telephos Domestic and Street Lighting Company, Ltd.), which were operated on the pressure-wave system. The Council have 1100 of these controllers, which are in perfect order. During this period of five years, the controllers have, we learn, given unqualified satisfaction; the only reason for their discontinuance being that the Council have their own electricity undertaking, and have decided to convert the gas-lamps to electricity. Consequently the Council have given instructions for the disposal of the controllers.

Monte Video Gas and Dry Dock Company, Ltd.—At the meeting of the Company next Wednesday (May 16), the accounts for the year ended Dec. 31 last will be submitted. The Directors will report that, after providing for interest on debenture stock and other charges, and including £14,010 brought forward from the previous year, the balance at the credit of profit and loss available for dividend is £35,753. An interim dividend of 2 p.ct. (free of income-tax) was paid in respect of the half-year ended June 30; and the Board now recommend the payment of a further dividend of 2 p.ct. (free of income-tax), making 4 p.ct. for the year, and carrying forward a balance of £14,076. The balance at the credit of reserve account remains at £52,500, the deferred maintenance account at £15,000, and the contingency account at £17,739. Compared with the previous year, the total gas sales show an increase of 1·09 p.ct. The dock and workshops department shows a large falling off in the amount of work done. Mr. T. F. Lane has retired from his position as General Manager at Monte Video, which he had held with distinction for thirty-three years. In recognition of this, and of his long service of fifty years with the Company, the Directors have elected him to a seat on the Board.

REGISTER OF PATENTS.

Large Capacity Gas-Meter.—No. 179,903.

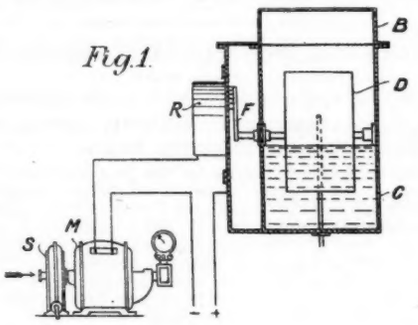
COMPAGNIE POUR LA FABRICATION DES COMPTEURS ET MATÉRIEL D'USINES À GAZ, of Paris.

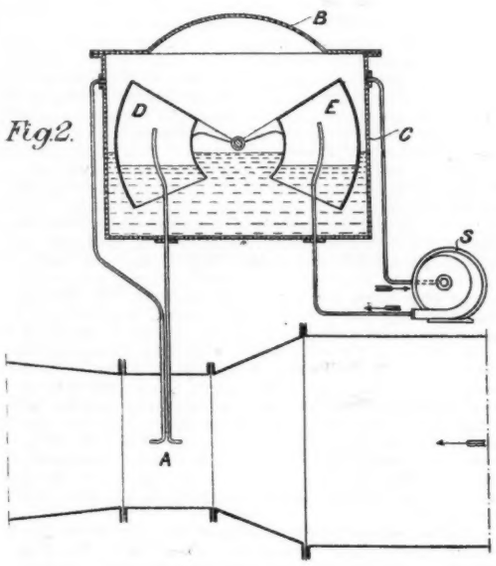
No. 4348; Feb. 14, 1922. Convention date, May 10, 1921.

This invention relates to a meter for compressed air or for gas particularly adapted to measure large outputs, and the use of which recommends itself in any case where it is impossible or objectionable to cause the compressed air or the gas to pass through a volume meter.

A meter is provided comprising a converging-diverging nozzle with a Pitot tube in the narrowest portion, a system of two oscillating bells internally connected—one with the up-stream branch of the Pitot tube, the other with the outlet end of a compressor; while the inlet of this compressor and the down-stream branch of the Pitot tube both communicate with the space above the bells.

One particular form of the apparatus is illustrated. Fig. 1 is a diagrammatic view, partly in section; while fig. 2 shows the apparatus, partly in section, in a plane at right angles to fig. 1. The





A French Large Capacity Gas-Meter.

converging-diverging nozzle A is introduced in the pipe through which the gas to be measured is flowing, and is provided with a Pitot tube with two bent branches—as shown in fig. 2—one in the direction of the current and the other in the opposite direction. The oscillating bell regulator B comprises a reservoir C containing water or glycerine or any other suitable non-volatile liquid, and two oscillating bells D, E, on the axis of which is keyed the arm F of a rheostat R. The rheostat itself is fixed outside the reservoir; but its contents are inside in order to avoid the use of a stuffing-box, which might be detrimental to the sensitiveness of the apparatus. This regulator is connected to the two branches of the Pitot tube so that the up-stream pressure arrives under the bell B and the down-stream pressure in the space above the two bells. This space is also in communication with the inlet of the centrifugal compressors; while the inside of the bell E communicates with the outlet of the same compressor. The latter S is driven by an electric motor M, the velocity of which is controlled by the rheostat. On the axis of the motor is mounted a totalizing tachometer, which indicates on the one hand the speed of the motor at any instant, and, on the other hand, totalizes the number of turns of the motor. The latter being proportional to the output, it is sufficient for measuring the output to provide in the counting train of wheels such intermediate transmission parts that each turn or fraction of a turn on the dials corresponds to cubic feet or other suitable unit. With the exception of the converging-diverging nozzle and of the constants of the apparatus, the same apparatus can be used for pipes of all diameters and for all outputs.

In operation, the bells D, E, being supposed in their position of equilibrium, a fall of pressure takes place between the space within and the space above the bell D, under the influence of the velocity of the gas on the one hand, which tends to cause the group to oscillate in a clockwise direction; on the other hand, the centrifugal compressor exerts on the bell E a counter-pressure which tends to cause the group to oscillate in the opposite direction. In the equilibrium position these two effects neutralize one another. If the output of the gas increases, the bell, receiving an increased thrust from this cause, causes the whole to rock in a clockwise direction, the arm F is moved so as to diminish the resistance in the rheostat R, the speed of the motor is accelerated, the pressure given by the compressor goes on increasing, and the inclination of the bell system stops when the two thrust are again equal. A diminution in the output would produce an opposite effect. Also, if the voltage of the electric current happens to increase, the motor, having a tendency to revolve faster, causes the compressor to generate a greater counter-pressure, which displaces the bell system and acts upon the rheostat to increase the resistance; the result is that the speed of the motor tends to diminish and to become normal again.

The centrifugal compressor and its motor may be of small size, so that the consumption of current is small (one-tenth horse-power at most). Owing to this small power, one can use universal motors working either with continuous or with alternating current. In pipes of rectangular section, which do not lend themselves conveniently to the fixing of a converging-diverging nozzle, the latter may be replaced by a diaphragm which will give a similar result.

Low-Temperature Carbonization.—No. 174,077.

WEISS, J., of Budapest.

No. 1069; Jan. 12, 1922. Convention date, Jan. 13, 1921.

The invention relates to a process for the production of low-temperature or primary tar, semi-coke, and gas by the low-temperature distillation of coal, cannel, lignite, and other carbonaceous material.

It has already been proposed to employ rotary kilns for the low-temperature distillation of coal with the production of low-temperature or primary tar. For example, the Thomas retort has been used for the production of illuminating gas. These furnaces are designed for external heating, and are consequently hardly suitable for the low-temperature distillation of inferior fuels, such as, for instance, brown coal and especially crude brown coal. Up to the present, however, internal heating has not been practically achieved.

The following claims are put forward by the patentee:

1. The process for the production of low-temperature tar, semi-coke, and gas from solid fuels, which consist in treating solid fuel in a rotary kiln, conducting the hot combustion gases for heating the fuel to be treated through the kiln in counter current to this fuel, and reducing the temperature of the heating gases before they encounter the fuel to a temperature suitable for the production of low-temperature tar, by the admixture of corresponding amounts of an inflammable gas of low temperature.

2. The process for the production of low-temperature tar, semi-coke, and gas from solid fuels as set forth in Claim 1, in which, for the purpose of increasing the heating value of the gas-mixture, the rotary kiln is heated by the combustion of a fuel dust by means of a coal-dust nozzle.

3. The process, as set forth in the preceding claims, for the production of low-temperature tar, semi-coke, and the largest possible output of inflammable gases from solid fuels, in which the rotary kiln is heated by means of the pulverized semi-coke produced in the kiln. This semi-coke is burned with a reduced air-supply in order to produce a gas mixture containing the maximum percentage of carbon monoxide.

4. The process for the production of low-temperature tar, semi-coke, and the largest possible output of inflammable gases from solid fuels as set forth in the preceding claims, in which the cooling of the combustion gases is effected before they meet the fuel to be treated, by circulating through the apparatus, in a closed circuit, part of the gases leaving the rotary kiln after having been freed from tar and, if desired, also from water vapour.

5. The process as set forth in the preceding claims, in which the inflammable cooling gases are preheated to a temperature between the lowest gas temperature and the optimum temperature for the production of low-temperature tar.

6. The process for the production of low-temperature tar, semi-coke, and gas by the low-temperature distillation of coal, cannel, lignite, or other carbonaceous material, substantially as described.

Gas-Lamps.—No. 194,760.

SUGG, WM., and CO., LTD., of Westminster, and MATTOCK, W. G. H., of Surbiton.

No. 30,868; Nov. 18, 1921.

This invention relates to gas-lamps of the inverted incandescent type, and especially to lamps for use out of doors. The object of the invention is to provide a lamp which can readily be dismantled for cleaning, and have a more simple means for preheating the air necessary for combustion than is the case with lamps generally in use.

According to the invention, a gas-lamp of the inverted incandescent type is provided with a diaphragm arranged above the mantles and with openings underneath the diaphragm to allow the escape of the products of combustion. The air for combustion is admitted through passages above the diaphragm, and is thereby heated. In order that certain parts of the lamp may readily be dismantled for cleaning, the nipple or gas regulator is held in position by a single stud, which may conveniently be hollow and screw into the gas supply tube. The bunsen or mixing tube, together with the superheater which supports the mantle or mantles, can, after the removal of the nipple, be removed by unscrewing a single nut.

In one way of carrying out the invention, the diaphragm is supported by a nut screwing on to a cylinder, which is fixed at its upper end to a plate forming the lower end of a stirrup. The lamp casing is of

conical shape, and is provided with a flange which rests upon the upper surface of the diaphragm and fits into the bottom of the stirrup. The air necessary for combustion is admitted through tubes which project from the periphery of the diaphragm and pass through a ring outside the lamp casing. The air passes through these tubes to the upper surface of the diaphragm and then through holes in the lower part of the cylinder, in which latter it rises and passes through an air sleeve to the mixing tube. The products of combustion escape through ports formed in the casing below the diaphragm, and are deflected by the ring so as to pass upwards outside the lamp and clear of the ends of the tubes for admitting air.

The mixing tube is threaded at its upper end to receive a nut which butts against an inner shoulder on the bottom of the fixed stirrup. At the lower end of the mixing tube is a superheating chamber which supports the mantles; and above the superheater is a shoulder, which may conveniently comprise a nut screwing upon the mixing tube so that its position can be adjusted. This nut or shoulder bears against the nut connecting the diaphragm to the fixed cylinder, and prevents the products of combustion from penetrating into the cylinder.

When it is desired to inspect the nipple or gas regulator it is only necessary to screw the locking nut downwards on the tube, and to screw up this latter into the top of the stirrup. The gas regulator and air sleeve can then be lifted out. To inspect the mixing tube, it is only necessary to remove the nut screwing on the end, when the mixing tube, with the mantles, can be withdrawn downwards without interfering with any of the casing. The gas regulator and air sleeve are preferably made in two separate pieces to facilitate their withdrawal and insertion.

Gas-Furnaces.—No. 195,225.

Sheard, J. T., and Rennison, F. T., both of Sheffield.

No. 3910; Feb. 10, 1922.

This invention relates to gas melting-furnaces in which the incoming gas or air, or both gas and air, are heated by the waste gases leaving the furnace.

It consists of an improved construction of such a furnace in which, by means of suitably arranged flues and gas and air passages, the gas and air are preheated, before combustion takes place, to such an extent that a very high intensity of combustion is realized. At the same time the temperature of the effluent gases is very greatly reduced before these leave the furnace; and this transference of heat, from the waste gases leaving the furnace to the gas and air entering it, results in considerable economy of fuel.

There is a central heating chamber in which combustion takes place. It may be either square or circular in plan. At approximately equal distances round its periphery, and at the same level, are four delivery ports or jets—two for gas and two for air—which are arranged in alternation, so that a gas jet is opposite to an air jet and an air jet is opposite to a gas jet. The central heating or combustion chamber is surrounded by the recuperating flues and gas and air passages, which are built in brick work and arranged in four series—one for each of the four ports or jets already described as delivering into the central heating or combustion chamber. There are thus four sets of recuperators arranged symmetrically round the combustion chamber, two of which are for heating the fuel gas, and two for the air to support combustion. In one example of a furnace constructed according to this invention, the products of combustion leave the heating or combustion chamber through ports or flues in the upper portion of the chamber, and travel in a downward direction to the underside of the heating chamber, and thence to flues in the side and end walls. The gas and the air to support combustion enter through suitable openings in the outer walls and travel, in the reverse direction to the waste gases, through flues or passages which are surrounded by those waste gases, whereby heat is transferred from the latter to the incoming air and gas. In such a furnace, burning ordinary town gas, a temperature of over 2000° C. has been obtained.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for May 2.]

Nos. 10,901 to 11,533.

Abbott, R. H. S.—"Distillation of coal, &c." No. 11,212.
Bourdon, A. V. A.—"Gas heating apparatus." No. 11,139.
Cox, W.—"Prepayment gas-meters." No. 11,067.
Cracknell, T.—"Gas-cocks." No. 11,156.
Davidson, T. M.—"Distillation of coal, &c." No. 11,212.
Dempster & Sons, Ltd., R.—"Manufacture of valve boxes, &c." No. 11,262.
Evans, E. V.—"Treating gases for removing carbon disulphide." No. 11,526.
Glover & Co., Ltd., G.—"Prepayment gas-meters." No. 11,067.
Hill, J. K.—"Liquid-meters." No. 11,329.
Sloman, J.—"Inverted gas-mantles." No. 11,194.
South Metropolitan Gas Company.—See Evans, E. V. No. 11,526.
Standard Gas-Fittings Company, Ltd.—See Cracknell, T. No. 11,156.
Stanier, H.—See Evans, E. V. No. 11,526.
Staples, C. W.—See Cox, W. No. 11,067.
Turner, C.—"Process of destructive distillation." No. 11,222.

APPLICATION FOR RESTORATION OF LAPSED PATENTS.

Notice is given that application has been made for the restoration of the following patents granted to James Leary Jackson, which have expired owing to the non-payment of the prescribed renewal fee in each case: 156,608 (548/21), 1916, "Improvements in valves;" 156,609 (549/21), 1915, "Improvements in gas-cut-off apparatus;" and 156,610 (550/21), 1914, "Improvements in gas-shut-off valves."

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Progress of Bills.

Hoylake and West Kirby Gas and Water Bill: Read a second time, and committed.

Oakham Gas and Electricity Bill: Read the third time, and passed; sent to the Commons.

HOUSE OF COMMONS.

Progress of Bills.

Oakham Gas and Electricity Bill: Read the first time, and referred to the Examiners.

Rawmarsh Urban District Council: Reported, with amendments, from the Local Legislation Committee.

Smethwick Corporation (Gas) Bill: Standing Orders not previously inquired into complied with; to be read a second time.

RAWMARSH URBAN DISTRICT COUNCIL BILL.

This Bill (see "Journal" for Feb. 14, p. 386) was considered by the Local Legislation Committee of the House of Commons, presided over by Sir Thomas Robinson, on Tuesday, May 1.

Mr. W. A. Donald (Counsel for the promoters) said that the Bill was a general powers Bill. Among other things, it sought to increase the general powers of the Rawmarsh Urban District Council in regard to their water and gas undertakings, and to maintain present charges, which were fixed by war legislation, and which would soon cease to operate if further legislation were not forthcoming. The limits of supply for gas by the promoters were not coterminous with the boundaries of the Urban District of Rawmarsh, but included part of the adjoining Urban District of Greasbrough.

The powers under which the promoters were authorized to manufacture and supply gas were contained in the Rawmarsh Local Board Act, 1879, the maximum charges then authorized being 3s. 3d. per 1000 c.ft. up to 44,500 c.ft., and 3s. 1d. beyond this. These maximum prices were increased by war legislation (which expires next month) to 5s. 9d. up to 44,500 c.ft., and 5s. 6d. beyond. The promoters now ask to be allowed to continue these prices for the present, owing to the grave position of the undertaking. A few years ago there was a serious explosion at the gas-works, when a good deal of damage was done. Unfortunately, the explosion did not extinguish the loan on the old buildings. New buildings had to be erected, and new works established; so that at the present time there were two sets of loan charges running, which accounted for the present position of the undertaking. It might be asked by the Committee whether, if the undertaking were empowered to charge at the extraordinary rate of 5s. 9d., they were not rather penalizing the ordinary consumer. The Committee might also ask how they were to know that the Council would reduce the charges when the time came for them to be reduced. In this connection, Counsel said that the Council were always faced with competition from the electricity undertaking of the County Borough of Rotherham, which had authority to supply electricity for lighting and power purposes in the Urban District of Rawmarsh. The Rotherham Corporation had one of the most efficient generating stations in the country, and he believed he was right in saying that the 30,000 kilowatt unit which they possessed was the only unit of this size actually working in the British Isles at the present time. If the gas undertaking of the Rawmarsh Urban District Council was called upon to meet competition from an efficient, up-to-date electricity generating station, it would of necessity keep its charge for gas down to the lowest possible figure.

In reply to a question by a member of the Committee, Counsel said that the generating station was only about two miles distant from Rawmarsh, so that the distribution costs for electricity were immaterial.

There were originally, said Counsel, petitions by railway companies, by Earl FitzWilliam, and by the Greasbrough Urban District Council; but clauses had been agreed between the parties concerned, and the opposition disposed of, subject to these clauses receiving the approval of the Committee. A new clause had been added to the Bill for the protection of the railway companies, which provided that the promoters should not exercise their powers with regard to the breaking-up of streets so as to obstruct or interfere with the convenient access to any street or road belonging to a railway company except with the consent of the company.

Dealing with a report from the Minister of Health on the Bill, Counsel said that reference had been made by the Minister to the fact that the powers sought in connection with the water and gas undertakings of the Council could have been obtained through the Ministry of Health and the Board of Trade respectively without coming to Parliament. It had been laid down by Sir William Middlebrook, who had presided over the Local Legislation Committee of the House in the last Parliament, that when a local authority came to Parliament for general powers which they could not obtain by other means (as in the present case), they would, naturally, include in their Bill powers for increased charges. The Council had, therefore, taken the obvious course of including in the Bill powers in regard to increased charges for gas and water.

Mr. Rhodes (Ministry of Health) said his point was that the powers in regard to water could have been obtained from the Ministry of Health, and those with regard to gas from the Board of Trade, and he doubted whether the powers sought in the Bill with regard to public health and local government generally were such as to justify the Council in incurring the expense of coming to Parliament. He sug-

gested that the Committee should discourage future Bills for the promotion of which there were insufficient grounds.

After the luncheon adjournment, the Committee decided that the preamble of the Bill with regard to water supply was proved, and went on to deal with the gas clauses. The clause giving power for the working-up and conversion of bye-products was slightly amended in order to confine the work to particular lands. As to the clauses with regard to the purchase and supply of coke-oven gas, these were regarded by the Board of Trade (said Counsel) as a superabundance of caution; but the Council wanted to be on the safe side, rather than to leave in doubt at some future date the question as to whether the power to manufacture coal gas included power to deal with coke-oven gas. They wanted to avoid an expensive fight if they were challenged. The clauses were approved.

The CHAIRMAN asked for evidence as to whether the continuation of the maximum price of 5s. 9d. was justified from now onwards.

Mr. ARTHUR JACKSON (Clerk to the Rawmarsh Urban District Council) said that the last statement of account showed a deficit on the working of the undertaking, and the Council wanted the powers to maintain the maximum price for quite another 2½ years. It was pretty well certain that after then they would be able to bring down the price of gas; but if they had to reduce the price now to the old rates, they would run up a big deficiency again. There was no question that the Council would reduce the price as soon as they could, because the existing price was creating somewhat of an agitation. The deficit for the year ended March 31, 1921, was £1311; for the year ended March 31, 1922, it was £1207; and for the year ended March last, it had been reduced to about £600 or £700.

Mr. J. W. BROWN (a member of the Committee) said that if the Council obtained a supply of coke-oven gas, they could supply more cheaply.

Mr. JACKSON said they would be able to reduce the cost by 2s. per 1000 c.ft. He believed the Council could get a supply of coke-oven gas at 9d. or 10d. per 1000 c.ft.; and he had been told that the cost of purifying it would be about 1d. or 2d.

Mr. W. RAINE (a member of the Committee) remarked that it appeared that, but for the high charge, the undertaking would have been in a bad way.

Mr. BROWN said that the public should have the benefit of a cheap gas supply. He understood it was not sought to spend money on the works and on experiments. If the Council had given a large maximum charge of 5s. 9d., and then obtained a cheap coke-oven gas, were they going to waste the money or give it to the consumers?

Mr. JACKSON said the benefit would go to the consumers. Competition with the Rotherham electricity department would compel them to do this.

Lieut.-Col. J. NALL (a member of the Committee) asked why it was necessary to resort to special powers for gas, because under the Gas Regulation Act there should be no difficulty in getting charges adjusted.

Mr. JACKSON replied that the only reason was that, having come to Parliament, it was just as well for the Council to incorporate these powers in the Bill.

Colonel NALL said that this was going behind a recent Act which consolidated the whole system of the gas industry. The Gas Regulation Act was the last word in the consolidation of machinery for adjusting charges, and there should be no difficulty. He asked whether the Council had applied to the Board of Trade for a Therm Order under this Act.

Mr. JACKSON said they had not.

Colonel NALL expressed a wish to hear what the Board of Trade had to say on this matter.

Mr. H. C. HONEY (Director of Gas Administration, Board of Trade), who attended at the request of the Committee, pointed out that the first recommendation of the Committee who had reported on the method of charging for gas on a thermal basis was that the method should be extended to all statutory gas undertakings within the scope of the Gas Regulation Act. This would apply to the Rawmarsh undertaking, which was a statutory concern. Therefore, the Board of Trade did not feel they ought to agree to such an undertaking remaining under the old system of charging and the old system of testing any longer than was absolutely necessary. The Board were unable to understand why, when the Rawmarsh Urban District Council were proposing to increase their charges, they should desire to continue to charge by volume. He suggested that they should, in the ordinary way, apply for an Order enabling them to charge on the thermal basis, with an increase in the maximum price. If the Committee, however, considered it desirable to give the Council some little time to set their house in order before the new system was adopted, he did not think the Board of Trade would have any objection. This had been done in the case of a good many Bills last year, when the promoters were placed under an obligation to apply to the Board of Trade within a certain period for an Order under the Gas Regulation Act. In these cases the promoters were given (temporarily) a maximum price per 1000 c.ft.

Mr. DONALD said the position was that the Rawmarsh Urban District Council did not like the therm method of charging. There would probably come a time when the whole country would be placed on a therm basis, and that was the time when they themselves wanted to come in. They did not think, however, that, merely because they asked for an increase of maximum charge, the opportunity should be taken to change from a system of charging which they understood to one which they did not understand. There was (rightly or wrongly) on the part of private consumers a strong feeling with regard to the therm method—they thought they were being charged for something which they did not get. Therefore, the Council asked for the powers contained in the Bill now; and if, and when, the country as a whole came under the therm basis of charging, they would come in with the rest.

The CHAIRMAN pointed out that the undertakings of the country were coming in, and this was the opportunity for the Rawmarsh undertaking to do so.

Mr. GEORGE DAFFIN (Assistant Works Manager) was then called to answer questions put by members of the Committee, and told Mr. Raine that he had not worked out how the public would be affected if the undertaking went over to the therm basis of charging.

In reply to COUNSEL, Mr. Daffin agreed that if a quantity of coke-oven gas were obtained, the undertaking would be able to meet the thermal requirements more easily; but the public would pay for an inferior article from the point of view of illumination, though they would gain in heat value. From the point of view of the Council, it would be an advantage to them to charge on the thermal basis; but from the point of view of the consumers it would be a disadvantage.

Mr. J. P. HOUFTON (a member of the Committee) asked why.

Mr. DAFFIN said it was because the gas was used for lighting purposes mostly. He believed that about 10 p.ct. of the burners in use by the consumers were of the flat-flame type.

Mr. HONEY, at the request of the Committee, then explained briefly the purpose of charging under the therm basis, pointing out that the consumer merely paid for the heat value he obtained.

Mr. HOUFTON said it was a system of reducing all qualities of gas to one common denominator.

Mr. DONALD: From the point of view of its heating, but not its lighting, value.

Mr. HOUFTON: Which is the true value of the gas?

Colonel NALL said that the Departmental Committee who had inquired into the therm method of charging had concluded that the system should be extended, and that was why the Board of Trade objected to the clause in the Bill which fixed the maximum price for gas on the volume basis.

Mr. HONEY agreed, and pointed out that the adoption of the therm system did not mean merely an alteration of the method of charging. The whole system under the Gas Regulation Act involved the supply of gas at an adequate pressure, and the testing of the gas to ensure that consumers received gas of the proper quality.

Replying to further questions, Mr. DAFFIN said that no opinion had been expressed in the Rawmarsh district as to whether or not the consumers would like to adopt the therm system.

The Committee then adjourned.

Wednesday, May 2.

On the resumption of the proceedings this morning, the CHAIRMAN asked that the Gas Engineer should give evidence. His object was to give the promoters an opportunity to speak as to the efficiency of the undertaking.

Mr. DAFFIN said the plant consisted of horizontal retorts, of the regenerative type, which were installed about ten years ago. Also, additions had been made to the plant during the war at the request of the Ministry of Munitions. A benzole plant had been installed at a cost of £1050. This had been paid for entirely; but the Council were unable to make use of it. Dealing with cost of manufacture and distribution of gas, he said that the cost of gas into the holder was 1s. 5d. per 1000 c.ft. He agreed that this was fairly high for a district which was situated in the coalfield; but he attributed the high cost of gas to the high price of coal. Though the district was in the coalfield, the price of coal was no less to them, because they did not take sufficient quantity to enable them to get a lower price. The maximum price paid for coal was £1 3s. 6d. This was not handled mechanically; and he estimated handling costs at about 1s. per ton. The cost of raw material for 1000 c.ft. of gas was about 10d.; and the cost of labour in getting the gas into the holder was 7d. On top of this there were management charges; but he had not worked out the cost of these per 1000 c.ft., nor the distribution charges. He then produced a statement which showed that the manufacturing charges in the year ended March 31, 1922, were £13,867, and distribution expenses £2998. Therefore (roughly) distribution costs were to manufacturing costs, 3 : 14.

The CHAIRMAN asked for separate works costs, distribution costs and loan charges.

Mr. DONALD said that manufacturing charges in the year ended March 31, 1922, amounted to (roughly) £14,000, distribution £3000, and general expenses £3000. Loan charges (which had been reduced consistently since 1918), together with other expenses, amounted to about £1500. The total cost, therefore, was about £22,000, which meant that manufacturing costs were 14 : 22. He could not reconcile that with the cost figure of 1s. 5d. per 1000 c.ft., the present selling price in the district being 5s. 3d.

The CHAIRMAN said it seemed clear that the promoters were not in a position to give a full analysis of their costs.

Dealing with the questions put to the witness by Mr. Houfton,

Mr. DONALD said the system adopted was to hand certain figures to an outside firm of chartered accountants, who kept separate accounts for the gas undertaking. This probably accounted for Mr. Daffin knowing so little about the costs.

Mr. HOUFTON said he wanted to get at why the costs were so high.

Mr. DAFFIN said the reason was that the undertaking had been through an abnormal time. The £1000 spent on the benzole plant had been a dead loss. Then, in 1918, there was an explosion. Again, before they could get the gas prices up they had had to cope with increased costs of labour and materials. They were now doing better; and they asked for the maximum price inserted in the Bill as a safeguard in the future. The present price was 5s. 3d., which was below the maximum.

Mr. HOUFTON asked witness if he were satisfied that the works were as efficient as it was possible to make them.

Mr. DAFFIN said they were, under present conditions. If the undertaking had been able to spend more money, they would have been able get better results. They should be able to put down more plant in the future than they had done in the past, and this was one reason they wanted to maintain the maximum price for a time. When they got into a better position financially, they would reduce the price of gas.

Replying to further questions, Mr. Daffin said he was not the Engineer of the undertaking; and Counsel explained that, as the promoters were under the impression that only practical questions would be asked, only Mr. Daffin, who knew the practical side, had attended.

Asked whether an inquiry had been made by the Rawmarsh Urban District Council with regard to the cost of gas, Counsel said that an accountant had been called in, and had reported on the matter. His

report, showing the cost, was now being considered by a special committee of inquiry.

Mr. W. J. Brown said he had been looking at accounts which had been handed in, and it appeared that the department had been very successful up to a certain point. Up to the end of 1920, something like £46,000 had been spent on the works. This had been wiped off, and at the present time there was only £9307 outstanding. The gas-works stood in the books of the Urban District Council at this figure. Did the witness consider them fairly efficient works at the present time?

Mr. Daffin said they were not as efficient as he would like them to be; but he agreed they were certainly worth more than £9307.

Mr. Brown asked whether witness thought the price charged at present was justified—namely, 5s. 3d. Only in the last two or three years had the undertaking gone wrong.

Mr. Daffin reiterated that the price asked for in the Bill was merely a safeguard against anything that might happen in the future.

Mr. Brown pointed out that the Committee had to protect the interests of the public, and if they gave the Council the latitude they asked for it might be abused. He also expressed a hope that an accountant would get out proper costs, so that the Committee would know what they were doing. He did not know that the accounts as he had them were in the form in which they were presented to the Urban District Council.

Answering further questions, witness said that the capacity of the works was 70,000,000 c.ft. per annum. The pressure at which the gas was supplied was 2 in. mostly. The quality was 500 B.Th.U., and the average obtained from a ton of coal was 11,000 c.ft., which was about 1000 c.ft. more than they were getting last year.

The Chairman asked whether it was the intention of the Urban District Council to charge against the undertaking all costs, but not to make a profit.

Mr. Donald said this was so, and the Council considered they ought to be able to make such charges as would enable them to build up a reasonable reserve.

After the Committee had deliberated in private,

The Chairman announced that the decision of the Committee was that the clause dealing with the maximum price should be struck out of the Bill, as well as all consequential clauses affecting the price of gas. This meant that the clause relating to the hire charge for pre-payment supply should also be struck out. He also pointed out that if the Council desired to increase the price of gas within the area, it was quite open to them to apply to the Board of Trade under the Act of 1920.

PLYMOUTH CORPORATION BILL.

This Bill (see "Journal," Feb. 14, p. 386) was ordered to await report by the Unopposed Committee of the House of Lords, presided over by the Lord Chairman, the Earl of Donoughmore, on Tuesday, May 1. There were no amendments affecting the gas clauses.

LEGAL INTELLIGENCE.

ELECTORS AND TRADERS IN OPPOSITION TO GAS CORPORATION.

Important Test Action in Edinburgh.

In Edinburgh Sheriff Court on Tuesday of last week, Sheriff Substitute Orr heard parties in an action raised at the instance of four ratepayers and electors in the city against the Corporation of Edinburgh. The pursuers were Messrs. John Keppie Paterson, J.P., Hugh Liddell, John Kyles, and George F. Simpson.

Pursuers ask the Court to ordain the defenders—the Corporation of Edinburgh—to allow them to inspect and examine the accounts as defined by section 144, sub-section 1, of the Edinburgh Boundaries Extension and Tramway Act, 1920, as kept by them for the year ended May 15, 1922, together with the auditor's confirmation thereof and special report thereon, if any examination of such accounts is sought for, at such reasonable times as the Court shall appoint, in terms of section 152 of the Act. The Court is asked to find and declare that the defenders are bound, on the pursuers each tendering to them a sum not exceeding 2s. 6d., to deliver to each of them an abstract of the accounts as defined above, and the auditor's confirmation and special report thereon, if any, as printed, and to ordain them on such tender being made to deliver the abstract, &c., accordingly. Further, to sustain the pursuers' objections to the item of £4063 contained in the abstracts of the City of Edinburgh gas supply accounts for the year ended May 15, 1922, under the heading "Rental of gas-fires, meters, &c.," and the sub-heading "Revenue account, gas-fires, &c.," in respect that the said account is erroneous and falls to be increased by the sum of £17,508, or such other sum as would have represented the amount of hires at reasonable rates of such gas appliances supplied by the defenders to consumers of gas, as were hired gratuitously or at inadequate rates by them; or otherwise to sustain the objection of the pursuers that the sum of £17,508, or alternative sum, is not included as a credit in the revenue account, and to ordain the defenders to rectify and alter the gas supply accounts so as to include the sum of £17 508 in one or other of the alternative methods set forth above; to ordain the defenders to set forth distinctly in the accounts and/or abstracts reasonably full and reasonably detailed entries, both of debit and credit, in relation to the carrying on by them of the showrooms during the year ended May 15. 1922, and to sustain the objection of the pursuers to the omission from the accounts and abstracts, and to find the defenders liable in expenses.

It was intimated on Tuesday that the Counsel briefed in the case are: For the complainers—Mr. Morrice Mackay, K.C., and Mr. Murray, advocate, instructed by Mr. J. Ferguson Reekie, S.S.C. For the respondents: Mr. D. P. Fleming, K.C., and Mr. Cooper, instructed by Mr. Grierson, Town Clerk for the City of Edinburgh. Mr. Murray opened the case for the complainers, and finished his speech, which was mainly a recapitulation of the arguments contained in the record. At the end of the day, the case was adjourned to a diet to be afterwards fixed for the fuller hearing of senior Counsel.

The pursuers, in their averments on record, state that the defenders charge an annual rent for the gas-fires; but the other appliances and the use thereof, are supplied to the consumers gratuitously. The installation, including fitting, setting up, altering, removing, and refixing of the whole appliances, is done gratuitously by the defenders. So far as the appliances are supplied gratuitously, or at inadequate prices on terms of hire, they are neither sold to the consumers nor let for hire to them. The cost for fitting and maintaining them on the premises of the consumers, and the charges and expenditure by the defenders relating thereto, in the year ended May 15, 1922, amounted to £21,571. The revenue for the appliances for the same period amounted to £4063; and there was accordingly a loss for the year of £17,508.

Exactly the same system of supply and of fitting, installing, &c., was being continued at the present time; and the defenders intended to follow it in future. The defenders are called upon to specify the terms and conditions on which these appliances are supplied. They are also called upon to specify the revenue alleged to have been received for gas consumed, and the profit alleged to have resulted to them from the supply of the appliances. Pursuers further contend that it is the duty of the defenders, in supplying the gas appliances, to provide and maintain them in such a manner that no loss will reasonably result in consequence of their so doing, and that by hiring them at such a rate as, taking them one with another over the period of account, would meet the total annual cost of providing, supplying, fitting, and maintaining these appliances for the year.

It is further averred that it is the duty of the defenders either to sell such appliances or to let them on hire, and not to donate the use of them or allow such use gratuitously and without remuneration or for an illusory return. These duties, the pursuers say, the defenders have neither fulfilled nor attempted to fulfil; and their failure to do so, or to attempt to do so, is *ultra vires* of their powers under the Acts, and contrary to public policy. The position, it is averred, is that the defenders, in contravention of section 77 of the Edinburgh and Leith Corporations Gas Act, 1888, gratuitously lent gas-stoves, ranges, rings, burners, grillers, and other appliances, and have in respect of the remaining appliances intentionally charged a rental so small as to preclude the possibility of a return which will meet the annual cost of providing and maintaining the appliances. It is claimed that there has been a corresponding loss in the years prior to the year 1921-22, and the action and course of dealing of the Corporation are being persisted in against the protests of the pursuers and other electors, and are such as necessarily to cause a considerable loss to the gas undertaking and to the consumers of gas in the city. The reasons for adopting these actions and course of dealing are not known to the pursuers, and the explanations and averments of the defenders are denied. In any event it is averred that the defenders are not entitled to issue on loan appliances contrary to the Act.

The pursuers on record quote the provisions of the Edinburgh Boundaries Extension and Tramways Act, 1920, as follows (section 143): "The Corporation shall cause to be kept books of accounts, showing all property heritable and movable vested in them, the nature of such property, and all rates or assessments levied, and all revenue and expenditure, and all outstanding balances due to or by them with balance applicable thereto on account of (*a*) the common good and revenue of the city; and (*b*) any rate of assessments levied or collected, monies realized, received, or borrowed by them under the Edinburgh Municipal and Police Acts or any other Act under which they are authorized to levy assessments, charge rates, or receive, uplift or borrow money; and notwithstanding anything contained in any Act, such accounts shall be made out for the year ending on the fifteenth day of May from what sources such rates, assessments, or monies have been received, and to what purposes the same have been applied. The said accounts, with the balance-sheets applicable thereto, are hereinafter in this part of this Act referred to as the accounts. (2) The Corporation shall cause the accounts to be made out separately and distinctly for (*a*) the common good, and (*b*) each department of the Corporation." Section 150: "The Corporation shall submit the accounts, together with their books and the proper vouchers in support of the same, to the auditor, and shall give him every reasonable facility for carrying out the audit." Section 151: "The yearly accounts, as the same shall have been audited, together with the auditor's confirmation thereof and special report thereon, if any, shall be laid before a meeting of the Corporation to be held not later than the fifteenth day of October in each year; and the accounts shall, if and as approved by the Corporation, be signed by the Lord Provost and also by the Treasurer of the City, and the Town Clerk; and shall be deposited with the City Chamberlain." By section 152 of the Act it is provided that: "The Corporation shall, after the accounts have been deposited with the City Chamberlain, cause the accounts or abstract of them to be printed, and permit any elector to inspect and examine them at all reasonable times without payment of any fee, and transmit them to the Secretary for Scotland, and on the demand of any elector and on payment of a fee not exceeding 2s. 6d., deliver to such elector an abstract of the accounts and the auditor's confirmation as printed."

The defenders, the pursuers allege, have had an abstract of the accounts prepared and printed with a view to carrying out their duty under section 152 of the Act of 1920, and have furnished the pursuers with a copy of the abstract after a demand made by letter in terms of section 152*c*. This abstract contains on the debtor side, under the heading "Revenue account gas cookers, hires, &c.," and the sub-heading "Fitting and maintaining gas-cookers, fires, and other appliances" an entry of £21,571; and on the credit side, under the heading "rental of gas-fires, meters, &c." an entry of £4063, which entries show a loss of £17,508 on the year's supply and maintenance of the appli-

ances. No particulars of these sums of £21,571 and £4063 are shown in the abstract.

Pursuers further allege that this loss is due to the illegal method of supply, lending, fitting, maintaining, altering, &c., gas appliances. It is a course of action which will result in a repetition of these or similar losses to the community. The pursuers have made repeated demands on the defenders to furnish particulars of these accounts; but the latter have refused to do so.

Pursuers further maintain that electors of the city are entitled, if dissatisfied with any of the accounts, to complain against the same by petition to the Sheriff under section 153 of the Act. Pursuers are dissatisfied, and are complaining against these accounts on the ground that the debtor and creditor entries have not been furnished by the defenders for examination or inspection; that the entry of £4063 is unwarranted and erroneous, and is illegal in respect that it represents only hires of a part of the gas appliances, and should have been increased by the amount of revenue calculated to have been earned, or which would have been earned, by the defenders' hiring the whole of the appliances at such adequate rates of hire as, taking them altogether, would suffice to meet the annual cost of providing, fitting, and maintaining them.

In connection with the supply of gas appliances, the defenders have, the pursuers say, purchased or leased premises of considerable extent, and at great cost, which they use as showrooms for exhibiting to intending customers and the general public gas-cookers, gas lighting and power apparatus, fittings, and other articles connected with the supply of gas to the city. They employ many officials, workmen, and servants whose sole duties are connected with these showrooms, and great expenditure is incurred in paying their salaries and wages. These showrooms constitute in practice a distinct department of the gas supply services. The accounts and abstracts prepared by the defenders should show in terms of the requirements of the Act of 1920, but do not show, the revenue, rental, purchase prices, salaries, wages, and other outgoings and incomings relating to the showrooms. It is in the public interest that the citizens should be provided, in the accounts, with these particulars.

Defenders in their answers to the pursuers admit they have control of, and are responsible for, the gas supply of the city; and they explain that the pursuers are all interested in gas-fitting businesses carried on in Edinburgh. The defenders supply on hire or loan to consumers gas fires and cookers, burners, grillers, and other appliances. An annual rent is charged for gas-fires; and other appliances are supplied without charging an annual rent. Defenders deny that the other appliances are supplied gratuitously, and state they are supplied on specific terms and conditions, and a return or consideration for their use is obtained in the sums paid for the amount of gas supplied. Defenders deny that the installation of the whole appliances is done gratuitously by them, and explain that the terms and conditions of supply provide for a certain amount of installation being carried out by them without any special charge. The cost of fitting and maintaining the various appliances, and other charges relating thereto, amounted to £21,571 for the year ended May 15, 1922; and this amount included £3032 for depreciation. They deny that the revenue from the appliances for the same period amounted to £4063, and that there is accordingly a loss for the year of £17,508. Apart from meters, the revenue for the year in respect of appliances included £4063 in respect of rental of gas-fires, and £6487 in respect of sale and fitting of gas appliances, &c. These two items only represented part of the revenue received in connection with the supply of apparatus, and the greater part of the revenue for the latter is included in the sums received for gas consumed. So far from there being a loss, the supply of appliances for the consumption of gas results in a substantial profit to the gas undertaking.

Defenders deny the averments of the pursuers with regard to the statutes regulating their undertaking; and they explain and aver further that the actings and course of dealing complained of are authorized by the statutory powers, and in particular by the Edinburgh and Leith Corporation Gas Act, 1888. These powers have been sought and adopted by them in their administration of the gas undertaking for the purpose of encouraging and developing the consumption of gas. Such action has very largely contributed to the success of the concern; it is not a source of loss but a source of gain to the undertaking and to the consumers, as it tends to cheapen the price of gas by reducing the burden of oncost charges; and the largest gas undertakings in the country adopt the same practice.

Defenders say they have refused to allow the pursuers to inspect or examine books of account referred to in section 143 of the Act of 1920, and they explain and aver that the pursuers are not entitled under the statute or otherwise to do so. They have already supplied the pursuers with the copy of accounts referred to in section 144. These are the accounts which were audited, submitted to, and approved by, the Corporation in terms of sections 150 and 151 of the Act. The only accounts kept by the defenders which the pursuers are entitled to see are the accounts of which copies have been so supplied and are now produced. While admitting that the pursuers, in terms of section 153, are entitled to complain to the Sheriff, the pursuers deny that the present application is competently presented under that section.

Defenders admit that they have purchased or leased premises in various parts of the city used *inter alia* as showrooms. These premises are branch offices, and form a necessary adjunct of the business of the undertaking; and their acquisition and maintenance are reasonably incidental to the exercise of their statutory powers. They are used as showrooms for display and demonstration of various appliances, and generally to spread a knowledge of the uses of gas; as offices for the receipt of orders for the supply of gas and appliances, and for bye-products; as branch offices for receiving and attending to complaints, and requests for turning on or off gas, and for altering, overhauling, or changing gas appliances, and for the payment of gas accounts; and as workshops and stores for the workmen of the undertaking on the district. These showrooms do not form "a department of the Corporation" within the meaning of section 144 of the Act of 1920. In view of the fact that these premises are utilized for many other purposes besides those of showrooms, they do not form a distinct or separate branch of the gas undertaking; and it is impracticable to keep accounts showing separately the expenditure and revenue applicable to the use of these premises as showrooms.

Defenders plead that the pursuers' averments being irrelevant and insufficient to support their case, the action should be dismissed.

CROSS v. IMPERIAL CONTINENTAL GAS ASSOCIATION.

Judgment.

In the Chancery Division of the High Court of Justice yesterday, Mr. Justice ROMER delivered his reserved judgment in this case in which the plaintiff suing, as a debenture holder on behalf of himself and all other holders of debentures in the Company, for an injunction restraining the Company from distributing a large sum by way of dividend on the ordinary shares without at the same time paying off the whole of the debenture debt, or at least, one quarter of it [see "JOURNAL" for April 25, p. 226].

His LORDSHIP, after referring to the various Acts under which the Company was constituted, and which empowered the payment of dividends and the creation of debenture stock, said the position and rights of debenture holders had been well settled by the Courts in many decided cases; and under the Act the Company had power to reduce the capital by returning money not required for the purposes of the Company. The Company had also power to borrow on mortgage or debentures; but the Act of 1883 prescribed that the mortgage debt should not exceed in amount one quarter of the ordinary capital. In 1915, the Company possessed valuable undertakings in Germany which, on the outbreak of the war, were placed under the administration of the German Government, and afterwards sold; the Company receiving as compensation a sum of £5,625,896. As these undertakings stood in the books at a sum of four millions odd, the Company made a profit by the sale of £1,467,194. Out of the money the Company had reduced the capital by returning a certain sum upon each share, and at the same time a proportionate part of the debenture debt was redeemed. No objection was raised at the time to this being done. As the sum of £1,467,194, being the balance of the compensation money, stood in the books as a book debt, the Directors had to decide what should be done with it. They decided to treat it as profit available for the purpose of dividend on the shares of the Company; and the legality of this was challenged by the present action. Plaintiff contended that the debenture stock constituted a specific charge on the undertakings in Germany, and these undertakings having been sold, the debenture holders were entitled to have the proceeds of the sale applied in reduction of the debenture debt, or, alternatively, that no part could be paid to the ordinary shareholders unless the outstanding debenture stock was redeemed to the extent of one quarter. The Company was not proposing to reduce the nominal capital or to return anything to the shareholders. The position of debenture holders had been clearly defined by a decision in the Court of Appeal—they had no interest in land, they had no right to take possession of any item of the Company whether in specie or in chattel, the only thing they had a charge upon was the net earnings of the Company. The debentures were not a charge upon the German property; and as no interest was in arrear, the holders of the debentures had no right to interfere with the right or possession of the ordinary shareholders. Any action therefore on the part of debenture holders could not be entertained. If the plaintiff was entitled to succeed as an ordinary member, he was in no better position by suing also as a debenture holder. As an ordinary member he could not impeach the legality of the proposed distribution unless it was in conflict with some statutory power. It could not be disputed that there had been a total appreciation of the capital assets. Capital stock did not mean capital assets, and there was nothing to prevent the Company from declaring a dividend out of its capital assets. The Company had power to sell any part of its undertaking and to receive compensation in respect thereof from the German Government, and to distribute the realized profits among the members. The result was the motion would be refused, the costs to be costs in the action.

Brentford and Richmond Gas Amalgamation Scheme.—A further gas amalgamation scheme is under discussion; the proposal now being for the acquisition by the Brentford Gas Company of the undertaking of the Richmond (Surrey) Gas Company. A provisional agreement has, it is stated, been signed; and when the negotiations are completed, a meeting of the shareholders of the Richmond Company will be called to consider the proposal.

Compliment to Hereford's Gas Manager.—Complimentary references were made to Mr. Arthur Roberts, the Hereford City Gas Engineer and Manager, at the Town Council meeting on Tuesday last week. Alderman Witts, in proposing the adoption of the Gas Committee's report, intimated that Mr. Roberts had done a great amount of work, and congratulated him on bringing this work to a successful issue. Mr. Rogers said he was much impressed when visiting the gas-works recently. The city ought to be proud of their Gas Manager.

Further Reduction in Price at Harrogate.—The Harrogate Gas Company announce that, from the reading of the meters for the quarter ended March 31, the gross price of gas will be reduced from 10d. to 9d. per therm. This is equivalent to a reduction of 4¼d. per 1000 c.ft. on the old basis of charge. After deduction of the discount of 10 p.ct. for prompt payment, the present price will be 8·1d. per therm (for 460 B.Th.U. gas), the equivalent of 3s. 1¼d. per 1000 c.ft. The reduction will be extended to consumers of gas through slot-meters.

Price of Gas in Edinburgh.—It was reported to the last meeting of the Edinburgh Corporation Gas Committee that there was a balance of £26,000 on the working of the undertaking for the current year. Owing to the uncertain situation on the Ruhr, which is affecting the price of coal in this country, it was considered advisable that there should be no reduction in the price of gas at the present time. It was hoped, however, if conditions again reached normal in regard to the price of coal in this country, that it might be possible to reduce the price of gas to Edinburgh consumed in the winter months.

MISCELLANEOUS NEWS.

CITY AND GUILDS OF LONDON EXAMINATIONS.

The following are the questions set in the recent City and Guilds of London Institute Examinations. The maximum number of marks obtainable is affixed to questions.

GAS ENGINEERING.

Examiner: Mr. Samuel Tagg, of Preston.

Grade I.

1. Describe the construction and method of working a regenerative setting of horizontal retorts. (45 marks.)
2. Describe the physical and chemical changes occurring during the carbonization of coal in horizontal retorts. (45)
3. Give a sketch and description of a retort-house governor. (35.)
4. Give a description, with sketches, of the construction of a carburetted water-gas plant. (40.)
5. Sketch, and give figured dimensions of, condensing plant for a make of 100,000 c.ft. per hour, and compare the relative advantages of air and water cooled condensers. (35)
6. Describe the method of working a set of oxide purifiers, and give the chemical reactions that occur. (40.)
7. How is the percentage of ammonia in gas liquor determined? State the difference between free and fixed ammonia. (30.)
8. Give a description of a recording pressure gauge, and state the amount of exhaust or pressure at the inlet and outlet of each section of plant during the period of maximum make. (30.)
9. Give an outline sectional sketch of a two-lift gasholder and tank. (30.)
10. Describe the method of testing consumers' meters before fixing on the district. (30.)

Final.

1. Describe the method of heating a regenerative setting of horizontal retorts from cold, and the control essential for the maintenance of heats. (45)
2. Discuss the relative advantages of horizontal and vertical retorts from the point of view of volume and composition of gas and bye-products produced, and fuel consumption required. (45.)
3. Give sketches showing the construction of a setting of vertical retorts with producer, indicating the travel of producer gas and secondary air. (40.)
4. Give a description, with sketches, of a machine for charging and discharging horizontal retorts. (35)
5. Describe the process of manufacturing carburetted water gas, giving the thermal and chemical changes involved. (35.)
6. Give an outline sketch of an arrangement of oxide purifiers for a make of three million c.ft. per day, and describe the method of working them. (40.)
7. Give a description, with sketches, of plant for the manufacture of sulphate of ammonia. (30.)
8. Give a description of the apparatus and method employed in the complete analysis of gas. (30.)
9. Describe the construction of a dry gas-meter. (30.)
10. State whether a gas of 400 B.Th.U. is more suitable for incandescent lighting than one of 500 B.Th.U., giving reasons for your answer. (30.)

GAS-FITTING.

Chief Examiner: Mr. R. J. Rogers, of Birmingham.

Grade II.—Practical.

(*Candidates must attempt all questions.*)

The following materials to be supplied to each candidate for Tests 1, 2, and 5: 2 ft. of ⅜-in. wrought-iron pipe, one ⅜-in. iron size lever cock, one ⅜-in. iron size nose piece, one ⅜-in. ball joint, one 3-in. ceiling rose, ¾ ft. of 2-in. lead, ½ ft. of ⅝-in. compo., and 2 ft. of ⅝-in. compo. piping, one 5-lt. meter union, one 50-lt. meter union, 1 ft. of ⅜-in. wrought-iron pipe, ¾ ft. of ½ in. brass pipe, ¾ ft. of ⅜-in. copper pipe.

1. With the materials provided, make the compo. and lead connections, to the dimensions shown in figs. 1 and 2 [top of next column]. (1¾ hours; 25 marks.
2. Make up a ⅜-in. wrought-iron pendant to the dimensions shown in fig. 3. (¾ hour; 25 marks.)
3. Adjust the burners on the gas-cooking stove to give the best results; also take the pressure with (*a*) oven burners on only, (*b*) with hotplate burners on only, (*c*) with all the burners on. Report the pressures to the Local Examiner. (½ hour; 25 marks.)
4. Inspect the burners fitted on the rail, and adjust them to give the best lighting results. Explain to the Local Examiner the candle power and consumption per hour of each burner. (½ hour; 25 marks.)
5. Cut and screw one thread on each of the following: ¾-in. barrel piece, 10¼ in. long; ½-in. brass piece, 7¼ in. long; ⅜-in. copper piece, 8½ in. long. (½ hour; 25 marks.)
6. Examine the low-pressure governor (1 in. size), and explain to the Local Examiner how it operates. State the advantages of a governor, and in what circumstances you would fix one. (½ hour; 25 marks.)

Grade II.—Viva Voce Questions.

(*All questions to be attempted.*)

1. What improvements have been made in a modern gas-fire to ensure silent burning? (10 marks)
2. What is the effect of glassware when fitted to an incandescent burner? Does the glassware have any influence on the lighting efficiency? (10).
3. What precaution would you take when fixing a gas-fire in front of an ordinary coal-grate to ensure satisfaction to the consumer? (10.)
4. What is the composition of gas-fire fuel radiants? (10.)

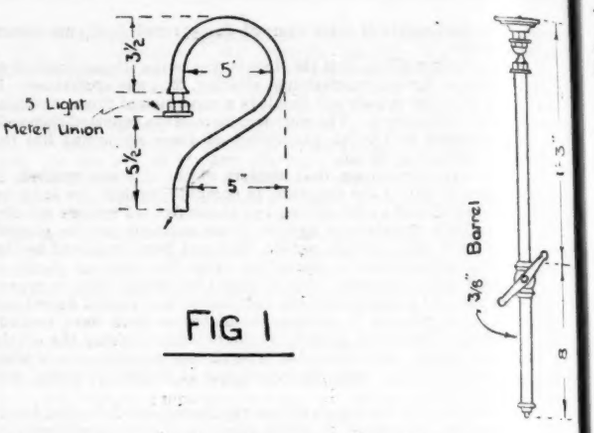


FIG 1

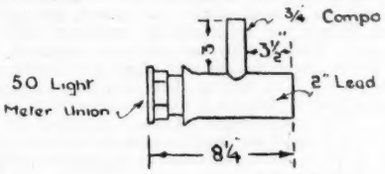


FIG 3

FIG 2.

5. How would you test for soundness an installation of gas-supply pipes—(*a*) if gas were available; (*b*) if no gas were available? (10.)
6. What is the proportion of air to gas when used for low-pressure incandescent lighting, and when used for a gas-engine? What is meant by (*a*) primary air; (*b*) secondary air? (10.)

Grade II.—Written.

(*Each candidate should attempt Questions 1 and 5, and not more than four other questions.*)

1. What would be the volume of water contained in a cylinder 24 in. in diameter and 36 in. deep? What type of gas-heated apparatus would you recommend to heat the water in the cylinder? (The water is required for baths and domestic purposes.) Give full reasons for your answer. (60 marks.)
2. You are asked to fix a gas-cooker in a small badly ventilated room. The consumer requires a flue pipe fitted to the oven; but there is no chimney available. How would you solve the problem? (50.)
3. What is the difference between an open type and a sealed type geyser? Which would you recommend for general use? Explain the reasons for your choice. (50.)
4. Explain the difference between a gas steam radiator and a gas steamless radiator. Explain the circumstances in which you would fix each type. (40.)
5. What tests would you make to ascertain whether the products of combustion from a gas-fire are entering the room? If you find it to be the case, how would you overcome the difficulty? (50.)
6. Name the various types of burners used for gas lighting. State the consumption per hour and the illuminating power of each. (40.)
7. How many "therms" are contained in 8700 c.ft. of 480 B.Th.U. per c.ft.? What would be the cost at 10½d. per therm? (40.)
8. Why is gas a good aid to ventilation? Describe one method of using gas for the purposes of ventilation. (50.)
9. State how you would deal with a person found unconscious in a room where gas was found to be escaping. (40.)

Final.—Practical Tests.

(*Candidates must attempt all questions.*)

The following materials to be supplied to each candidate for Tests 1 and 2: 2¼ ft. of 1½-in. lead pipe; 1 ft. of ⅝-in. compo.; one 50-lt. meter union; one 5-lt. meter union; 6 ft. of ¾-in. iron barrel pipe.

1. With the lead and compo. pipe provided, make a 1½-in. lead bend

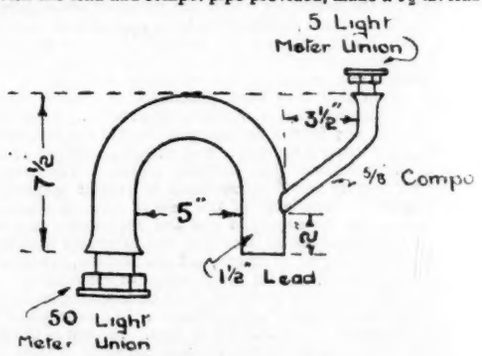


Fig 1.—Question 1.

with a $\frac{3}{8}$ in. compo. branch piece to the dimensions shown in fig. 1. ($1\frac{3}{4}$ hours; 25 marks.)

2. With the material provided, make a set in $\frac{3}{4}$-in. iron barrel to the

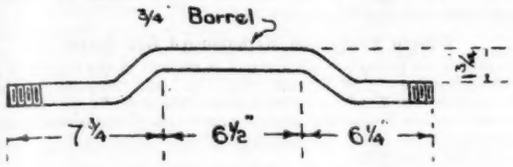


Fig 2.—Question 2.

measurements shown in fig. 2. A $\frac{3}{4}$-in. thread is to be left on each end. ($\frac{3}{4}$ hour; 25 marks.)

3. Take all the removable parts from the gas-fire, and explain to the Local Examiner the functions of each part; re-assemble the fire and adjust the burner to give the best results. ($\frac{1}{2}$ hour; 25 marks.)

4 Inspect the sketch of a gas-heated hot-water installation shown in fig. 3. Explain to the Local Examiner how this works, and point out

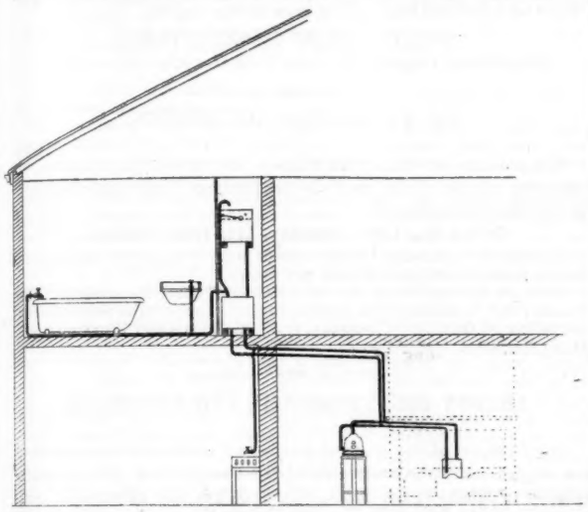


Fig. 3.—Question 4.

if there are any defects, and (if so) how you would remedy them. ($\frac{1}{2}$ hour; 25 marks.)

5. Inspect the portable pressure recorder, and describe its construction. Place a chart on the cylinder, and explain to the Local Examiner how you would fix the register to obtain the pressures at the inlet of a consumer's meter. ($\frac{1}{2}$ hour; 25 marks.)

6. Inspect the thermostat of a gas-heated hot-water circulator and explain to the Local Examiner the utility of the thermostat and precisely how it works. ($\frac{1}{2}$ hour; 25 marks.)

FINAL.—VIVA VOCE QUESTIONS.

(All questions to be attempted.)

1. A consumer complains of a strong smell of gas in a room. How would you deal with the complaint if (*a*) on examination you found the internal gas-supply pipes unsound; (*b*) the internal gas-supply pipes were found to be sound, but gas was still very noticeable in the room? (10 marks.)

2. A consumer uses gas on his works for lighting, muffles, and power purposes. He complains of a general shortage of gas. How would you deal with such a complaint, and what steps would you take to localize the trouble? (10.)

3. How would you prevent soot and mortar falling through a gas-fire flue, if the gas-fire were fitted in front of a coal-grate which had a sloping firebrick back? (10.)

4. What is meant by the terms: I.H.P.; B.H.P.; convection; B.Th.U.; flame temperature? (10)

5. How can the gas lighting of interiors be made to assist ventilation? (10.)

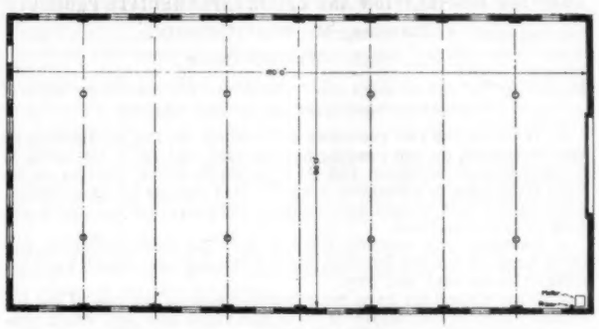
6. What are the advantages and disadvantages of flue pipe used in conjunction with gas cooking stoves? (10.)

FINAL.—WRITTEN PAPER.

(Every Candidate should attempt Questions 1 and 6, and not more than four others)

1. The diagrams show the plan and elevation of a workshop.* The positions of lighting points are indicated by an O. The lamps to be used contain four No. 2 inverted burners, and are to be fitted 12 ft. 6 in. from floor level to mantles. What system would you adopt for lighting and extinguishing the lamps simultaneously from the position marked "Riser" near the meter? Describe the following: (*a*) Size of service required (premises 30 ft. from main in roadway). (*b*) Size of gas-meter required. (*c*) Quantity and size of supply-pipe, and all fittings required in fitting-up meter and gas supplies in the workshop, taking into account the automatic control of lamps. (*d*) The time that you estimate would be required for fitting the meter, supply-pipes, and lamps. (60 marks.) [*See top of next column.]

2. Name the various types of gas-heated radiators in use, and explain the circumstances in which you would use each of them. (40.)



3. In what way does a wet meter differ from a dry meter? State the considerations to be borne in mind when deciding upon the positions for fixing: (*a*) A wet meter; (*b*) a dry meter. State the effect of overworking: (*a*) A wet meter; (*b*) a dry meterr. (50.)

4. State the common faults which arise from time to time in the working of a gas-engine. What points have to be observed in the fixing of the gas supply, water tanks, circulating pipes, and exhaust pipes for a gas-engine, to ensure efficient working? (50.)

5. You are asked to supply and fix a gas-heated circulator to give two hot baths of 20 gallons each in succession. Describe by means of a sketch how you would fit-up the installation, stating the size of circulator, size of gas-supply pipe, the consumption of gas per hour, the size of cold water feed tank and hot water cylinder, and the size and type of flow and return pipes that you would fix. The calorific value of the gas is to be assumed as 500 B.Th.U. per c.ft. (50.)

6. Describe by means of a sketch any instrument used for detecting a leakage of gas, and explain precisely how you would use it, assuming that gas was entering the premises from the roadway. (50.)

7. State, in order of importance, the chief points that have to be observed by a gas-fitter so as to ensure safety and efficiency when fixing a geyser in a bathroom. (40.)

8. Explain, in detail, any improvements which have recently been effected in the design of the hotplates of gas-cookers. Describe the effect of the alterations on the efficiency of the hotplate. (40.)

9. What is the proportion of (*a*) radiant heat, (*b*) convected heat, obtained from a modern gas-fire? What proportion of heat is used for ventilating the room in which the fire is fitted? (40.)

COKE AND BYE-PRODUCTS MANUFACTURE.

Examiner: Mr. C. P. FINN, B.Sc., F.I.C.

FINAL.

(Not more than eight questions to be attempted.)

1. Discuss the effects of carbonizing wet slack. Describe, illustrating with sketches: (1) Plant suitable for reducing the amount of water below that usually present in coking coal as it leaves the troughs or wash-boxes of a washer; (2) any method of dealing with slack containing large amounts of very fine material. (35.)

2. It is proposed to utilize for town's supply the available surplus coke-oven gas from a battery of 50 regenerative ovens (10-ton capacity), carbonizing an average South Yorkshire coal. What would you estimate to be the amount available; and what precautions are essential to ensuring regularity of the quantity and quality of the supply? Describe the apparatus necessary (including a suitable type of meter) to deliver crude gas to a purifying plant two miles distant. (45.)

3. Write a short essay on systems of quenching and handling coke from discharging to loading into wagons, indicating the advantages and drawbacks of each system. (40.)

4. Give full details of methods used in any three of the following determinations: (*a*) Porosity (open and closed) of a sample of coke; (*b*) phosphorus in coke; (*c*) (i.) thiophene and (ii.) carbon disulphide in crude benzole; (*d*) "free carbon" in pitch.

5. Describe, with approximately dimensioned sketches, a suitable plant for dealing with the output of tar from the coke-oven plant mentioned in Question 2.

6. In the manufacture of sulphate of ammonia from ammoniacal liquor there are products other than the finished salt. Indicate these, and give their approximate chemical composition. What methods are in use for the disposal of these products? (40.)

7. Write an account of the methods usually employed in recovering crude benzole from coke-oven gas, and explain briefly the physical principles involved. What precautions are necessary to ensure the maximum yields? How would you arrive at the efficiency of a plant? (40.)

8. Sketch and describe the apparatus in general use between the collecting main and the saturator outlet on a "direct" plant. (35.)

9. Explain the causes that bring about the following abnormalities, and the steps you would take to ensure normal products: (*a*) High sulphur content of coke and benzole; (*b*) paraffinoid benzole; (*c*) sulphate of ammonia discoloration (neither white nor grey). (35.)

10. Write an account (approximately 300 words) of any recent investigation having a bearing on the coke-oven industry. (45.)

COAL-TAR DISTILLATION AND CRUDE INTERMEDIATE PRODUCTS.

Examiner: Mr. W. H. Coleman.

Final.—Written Paper.

(*Not more than six questions to be attempted. The maximum number of marks obtainable is the same for each question.*)

1. Which of the two processes of distilling tar, the intermittent or the continuous, do you consider best adapted for: (*a*) A tar-works at a gas or coke-oven works, and (*b*) a tar-works which receives its tar from several gas or coke-oven works? Give reasons for your choice, and a sketch with a short description of the plant that you would employ in the second case.

2. Describe, with sketches showing only the essential details, any three forms of modern fractionating column, and state which you consider to be the best, and why.

3. What objections have been brought against the use of tar for roads? Discuss the validity of these, and show how you would prepare a tar suitable for road work.

4. Supposing that a largely-increased demand arose for anthracene and carbazole, what steps would you suggest taking in order to increase the recovery yield of these bodies from tar? Describe the process of manufacturing 95 p.ct. anthracene, stating the principles involved, and sketch the plant required.

5. Give a short but complete account of any three of the following tests: (*a*) The estimation of sulphur in motor benzole; (*b*) the estimation of thiophene in benzole for the colour industry; (*c*) the estimation of anthracene in anthracene paste, and the determination of its suitability for the colour industry; (*d*) the estimation of real phenol in 60's carbolic; (*e*) the examination of a sample of pitch with a view to determining its suitability for use in briquetting small coal.

6. Describe two of the many processes suggested for making neutral dry sulphate, and say which you consider to be the best, and why; also state the advantages of making neutral dry sulphate.

7. Describe as fully as possible any two recently-published processes connected with tar distilling, and give your opinion (with reasons) as to their practicability.

8. Give some account of the special dangers to which workers in tar-distilling establishments are exposed, and say what you would do (*a*) to avoid the occurrence of mishaps, and (*b*) to deal with any case that may have occurred.

Final.—Practical Test.

(*The maximum number of marks obtainable is the same for each question. All the questions may be attempted if time allows; but full marks can be obtained from three satisfactory answers.*)

1. What is sample A? Examine it and report on its quality.

2. Distil sample B in a side-tube flask. (Thermometer bulb to be in vapour). Tabulate your results, and draw a curve on the squared paper provided suitable for comparing the results with those from a standard sample.

3. In the sample of crude tar C estimate the water, and find the percentages distilling up to 170° C., and from 170° to 270° C. (Thermometer bulb to be in vapour). Do you consider that this tar is likely to give trouble on distillation in the works?

4. What is sample D? Estimate the ammonia present, and calculate the percentage purity of the sample.

Stockton and the Gas Regulation Act.

It was reported to the Stockton-on-Tees Corporation last week that their Parliamentary Agents had had an interview with the Parliamentary Agents of the neighbouring borough of Thornaby, relative to Stockton's application under the Gas Regulation Act; and that the three particular points upon which the latter required to be satisfied were: That the same price should be charged for gas in Thornaby as in Stockton; that there should be a testing-place at Thornaby; and that there should be some reduction in the proposed maximum price. A deputation from Thornaby had met the Corporation Gas Committee, when the second and third points were discussed at length; the Committee having already agreed that the same price should be charged for gas in Thornaby as in Stockton. It was pointed out to the deputation that to instal a testing-place meant a considerable capital outlay, as well as an annual expenditure; and that with regard to the proposed maximum price, it would only be charged in emergency. Past experience showed that over a considerable number of years the maximum price of gas had been considerably below the actual statutory figure. The deputation intimated that their Parliamentary Agents would be communicated with, and would let Stockton know whether it was Thornaby's intention still to oppose the Order.

Yorkshire Gas Prices.—The Shipley District Council decided last week to make application for power under the Gas Regulation Act, 1920, to charge a maximum of 1s. 2½d. per therm. It was hoped the actual price charged would be 1s. 1d.—equal to 5s. 5d. per 1000 c.ft.—the pre-war basis. The present price is 6s. 8d. per 1000 c.ft., but must revert to 5s. 5d. at the end of August, when the Temporary Increases Order ceases to function. The Batley Town Council have adopted a reduced scale of charges, to operate as from April 1. For domestic consumers the price is reduced from 6s. to 5s. 6d. per 1000 c.ft., which, after allowing a discount, amounts to 5s. 1d.; for heating and cooking, from 6s. to 5s. (4s. 7d. net); and for industrial uses, from 6s. to 4s. 7d. net. It is proposed to adopt the system of standard requirement, estimating the gas for lighting on the size of the rooms; all gas used in excess of this being charged as for cooking or heating. Consumers not desiring this system can have a separate meter at their own cost. Doncaster's charge for gas, under the Temporary Increases Order (which expires on Aug. 31), has been 5s. 3d. per 1000 c.ft. maximum; and the Committee propose to apply for power to charge a price per therm approximating as nearly as possible to 5s. 3d. per 1000 c.ft. The Filey District Council have reduced the price of gas by 1s. 4d. per 1000 c.ft. as from July 1—from 5s. 10d. to 4s. 6d.

GAS REGULATION ACT APPLICATIONS.

The following further notices have appeared in the "London Gazette" with regard to applications to the Board of Trade for Orders under the Gas Regulation Act.

Hebden Bridge and Mytholmroyd Gas Board.

The maximum price now authorized in respect of the supply of gas by the undertakers is 4s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 6d. per therm.

By the Hebden Bridge and Mytholmroyd Gas (Temporary Increase of Charges) Order, 1918, the maximum price is temporarily increased to 6s. 9d. per 1000 c.ft.

Pontefract Corporation.

The maximum price now authorized in respect of the supply of gas by the undertakers is 4s. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 4·4d. per therm.

SPECIAL ORDER.

Bromsgrove Gas Light and Coke Company.

The Company are applying to the Board of Trade for a Special Order under section 10 to empower them to construct and maintain gas-works on scheduled land, and to raise further capital.

DECLARATION OF CALORIFIC POWER.

Glastonbury Corporation.—500 B.Th.U. (July 1.)

GAS REGULATION ACT ORDERS.

The Director of Gas Administration has forwarded a copy of the following further Order made by the Board of Trade under section 1 of the Gas Regulation Act.

British Gas Light Company, Ltd. (Hull Station).

After the declared date, the maximum price in respect of gas supplied by the undertakers shall be 15d. per therm.

After the declared date, the word "therm" shall be substituted for "1000 c.ft." in section XVI. (power to Company to light public lamps) of the British Gas Light Company, Ltd. (Saltcoats and Kingston-upon-Hull) Act, 1858. (April 30.)

LONDON COUNTY COUNCIL AND GAS-MAINS.

On the report of the General Purposes Committee, with regard to the suggestions of the conference of representatives of various bodies relative to defects in gas-mains, escapes of gas, and gas-fittings [*ante*, p. 299], coming before the London County Council at their meeting last week,

Mr. Percy Harris, M.P., recalled the fact that a short time ago there was a number of accidents in various parts of London due to the escape of gas caused by the breaking of gas-mains, and referred particularly to the fatality at Gales Gardens, Bethnal Green. In view of the conference called by the Board of Trade, the Government decided to take no action at that particular time; and he thought the present report was largely side-tracking a very important and serious question. All that was proposed would not make any material difference. The intelligence of the average citizen might be very low; but he did not think it could be seriously suggested that the average person did not know that gas was dangerous, and that to leave a gas-tap on, or to allow gas to escape, was likely to lead to an accident which might have fatal consequences. He suggested that the present report should go to the Public Control Committee, and that they ought not to be led astray into thinking that this was an adequate proposal dealing with an urgent and important question. A good suggestion had been made that gas examiners should have power to report the percentage of carbon monoxide in gas. Another thing with which the report did not deal was the question whether, in view of the heavy traffic now using the roads, a bigger thrust should not be required in the road than was needed in the old days. When he saw the condition of the road at Bethnal Green, he was surprised at the small distance from the surface to where the gas-main was laid. As a great public authority, they should take more notice of these accidents due to faulty gas-pipes. They would incur serious responsibility if they took up the position that the present report was in any way adequate. If it should get abroad that they thought the recommendations of the Board of Trade Conference were by any means adequate and satisfactory, they would lay themselves open to much criticism.

Sir John Gilbert (Chairman of the General Purposes Committee) explained that, having regard to the fact that the report affected two Committees of the Council—the Highways and Public Control Committees—it automatically went to the General Purposes Committee. It might interest Mr. Harris to know that the Public Control Committee had appointed a Special Sub-Committee to look into the matter.

The recommendations of the General Purposes Committee were then adopted.

Darwen Price Again Reduced.—The price of gas at Darwen has been further reduced 4d. per 1000 c.ft., as from March 31.

Another Reduction at Bournemouth.—The Bournemouth Corporation have received a letter from the Bournemouth Gas and Water Company stating that the Directors had decided, as from the Lady-day readings, to reduce the price of gas by 0·4d. per therm, to 8·6d. per therm, which is equal to approximately 3s. 2¾d. per 1000 c.ft. It was pointed out that this reduction represented a saving of £12,000 per annum to the consumers, and that the price of gas now stood at only 29 p.ct. above the pre-war figure. Also that since Jan. 1, 1922, the reduced costs of manufacture had enabled the Company to make a reduction in the price of gas equivalent to 1s. 6¾d. per 1000 c.ft.

HARROW AND BRENTFORD AMALGAMATION.

Scheme Adopted by Harrow Stockholders.

At an Extraordinary Meeting of the Harrow and Stanmore Gas Company, held at No. 5, Great Winchester Street, E.C., on Monday of last week, the large number of proprietors present unanimously adopted the agreement submitted for the sale of the undertaking to the Brentford Gas Company. Mr. ARTHUR F. PHILLIPS (the Chairman) presided.

The agreement provides for the issue to holders of ordinary and preference stock and debenture stock of the Harrow and Stanmore Gas Company of ordinary or preference stock or debenture stock of the Brentford Gas Company, at the following rates:

For each £100 of ordinary stock of the Harrow and Stanmore Gas Company, £112 10s. "B" consolidated stock of the Brentford Gas Company.

For each £100 of 5 p.ct. consolidated preference stock of the Harrow and Stanmore Gas Company, £100 of 5 p.ct. preference stock of the Brentford Gas Company.

For each £100 of 4 p.ct. debenture stock of the Harrow and Stanmore Gas Company, £100 of 4 p.ct. debenture stock of the Brentford Gas Company.

For each £100 of 5 p.ct. debenture stock of the Harrow and Stanmore Gas Company, £125 of 4 p.ct. debenture stock of the Brentford Gas Company.

The ENGINEER and SECRETARY (Mr. Charles Chambers) having read the notice convening the meeting,

The CHAIRMAN said that the advisability of the Harrow Gas Company amalgamating with the Brentford Gas Company had been under consideration for some time. The limits of the two Companies joined for some considerable distance, and that of Brentford ran some way into the limits of the Harrow Company; and for several years the Harrow Company had found it convenient to take gas from Brentford for the supply of some of their customers. The output of gas from the Harrow works had arrived at the limit of their capacity; and the rapidly increasing consumption could only be met by considerable extension of the gas-works and mains, the cost of which would probably reduce the dividend for a time. The area of the Harrow Gas-Works was too limited to admit of any large extension; and being a residential neighbourhood, it might not be thought desirable to have a large gas-works in it. There was only a branch line of rail, which would make it difficult to receive large quantities of coal and send away the coke. The Brentford boundary at Sudbury was only a mile distant from the Harrow Gas-Works; and the Southall works had more than sufficient plant unemployed to produce all the gas required for Harrow. There was also a large main approaching the Harrow district. The Southall works had communications both by rail and by water. They had every modern improvement, with mechanical appliances for producing gas economically, and there was an excellent bye-products installation for working-up the tar and ammoniacal liquor. It would be evident that, at a large works like Southall, gas would be produced much cheaper than at Harrow. The Brentford Company had extensive and well-equipped workshops for the repairs of meters and stoves; which was a great saving over sending them away to be repaired. There were also excellent workshops for the repair of machinery and plant, and a foundry. He might remind them that the Brentford Gas Company was incorporated in 1821; that it was the third largest in the metropolitan area, and the sixth or seventh largest in the kingdom. It had 128,827 consumers, and the gas sold per annum was 4,619,083,000 c.ft., which made it an admirable company with which to amalgamate. For these reasons, amalgamation between the two Companies was desirable, and should result in reducing the price of gas and increasing the dividend. The capital of the two Companies being about the same per 1000 c.ft. of gas sold made the conditions for amalgamation favourable, though it must be remembered that Brentford had surplus plant, whereas Harrow was fully employed. The terms of purchase of £112 10s. of Brentford stock for each £100, of Harrow stock were advantageous, as the Harrow stockholder would not only have an increase in his dividend, but his stock would be more marketable, as it would be in a quoted company. Taking recent transactions, while the highest price obtained for Harrow stock was £92, Brentford stock had sold at from £98 to £102. The amalgation would result in a considerable saving in expense; and a large gas undertaking like Brentford could employ skilled technical officers to superintend the business, which a small company could not do. He was going to propose a resolution which he hoped would be unanimously adopted. Before coming to the decision to advise the amalgamation of the Harrow Company with the Brentford Company, the Directors gave the matter the greatest consideration; and they had had the assistance of their Auditor, Mr. B. Dannett Holroyd, in the examination of accounts and the effect of the amalgamation. They had also had the assistance of their solicitor, to see that the agreement was just and equitable. He could assure the proprietors that the Directors used every endeavour to obtain favourable terms. Briefly, the result of the amalgamation would be that the Harrow stockholders would have 15s. increase in the dividend, while Brentford paid only 6¼ p.ct., with a prospect of an increased dividend. Any Harrow proprietor wishing to dispose of his stock would gain over 20 p.ct., because Harrow stock sold at 92 and Brentford at 100; and this was in addition to the £12 10s. The consumers in Harrow would certainly have the prospect of reductions in the price of gas, which could be produced at less cost at the Brentford Company's works. He concluded by moving the following: "Resolved that the agreement dated April 18, 1923, and made between the Harrow and Stanmore Gas Company of the one part and the Brentford Gas Company of the other part, for the sale to the Brentford Gas Company of the undertaking of the Harrow and Stanmore Gas Company be, and the same is, hereby approved, subject to such alterations as may be made in the said agreement or in any special order for giving effect to the provisions thereof, for which application may be made under section 10 of the Gas Regulation Act, 1920, and as may be approved of by the Directors of the Harrow and Stanmore Gas Company.

The VICE-CHAIRMAN (Dr. J. W. Lee Glaisher, F.R.S.) seconded the resolution, and endorsed all that the Chairman had said with regard to the advantages of the proposed amalgamation. The Board had gone into the matter with extreme care. Speaking as one of the largest stockholders, and a Director of very many years' standing, he regarded the terms as perfectly satisfactory, both to the Harrow stockholders and the consumers.

A few questions were asked, mainly with the object of ascertaining what possible steps had been taken to protect the staff and employees who have served the Harrow Company so well; and after the CHAIRMAN'S answers on this point, the resolution was put to the meeting, and, as already stated, unanimously carried.

The CHAIRMAN said he did not expect the matter could be got through before July, so that the Harrow Company would be free in the matter of the next dividend.

On the proposition of Mr. F. J. BANCROFT, seconded by Mr. W. G. BEAUMONT, a hearty vote of thanks was passed to the Chairman and Directors, of whose action the proprietors had just approved.

CHESTERFIELD AND COKE-OVEN GAS.

An inquiry was held at Chesterfield last Friday by Mr. F. Gregson Williams, of the Ministry of Health, into the application of the Corporation for power to borrow £5600 to meet the cost of laying mains in connection with an agreement they have entered into with the Grassmoor Company for the supply of coke-oven gas in increased bulk.

The Gas Engineer (Mr. H. Davies) explained that the gas undertaking at Chesterfield was self-supporting. The chief reason why an increased supply of coke-oven gas was being secured was in order that the renewal of the carbonizing plant at the gas-works might be undertaken. As a first instalment of the renewal scheme, he had been instructed to submit plans and estimates for the erection of six beds, each of ten 20 ft. horizontal retorts, with the necessary coal and coke handling plant. He pointed out that coke-oven gas could be bought at as cheap a price as the Corporation could produce gas; and the agreed price was based on a sliding-scale under which the charge for coke-oven gas went down as the price of coal at the pit fell. The Corporation considered they had made an excellent bargain provided they could make arrangements for getting the gas to the central works, 3½ miles away, and for distributing it to the consumers. Mr. Davies said the great advantage of taking coke-oven gas was that it would obviate, for the time being, the necessity of erecting a new carbonizing plant at a cost of £20,000. Already the Corporation were taking a small quantity of gas from the Grassmoor Company, which arrangement had been the means of saving much expense in the laying of mains. It was the intention of the Corporation to take the Grassmoor supply at high pressure in three or four times the present quantity.

Asked by the Inspector as to whether the Corporation were making or losing money on the coke-oven supply, Mr. Davies said they were making money, but not very much. He then alluded to the hand-stoked gas-works at Willington, which were bought on the extension of the Borough, and said it might be possible to close down these works. At the central works there was a water-gas plant of a capacity of 500,000 c.ft. per day; but he urged that it was not policy to mix water-gas with coal-gas in a greater proportion than one-fourth.

The inquiry was then closed; there being no opposition.

NELSON CORPORATION GAS DEPARTMENT.

Annual Report.

Mr. James Mitchell, the Engineer and General Manager, has submitted his fourth annual report to the Gas Committee of the Borough of Nelson.

During the year ended March 31, the expenditure on revenue account was £117,026, and the income £134,907. The result was a gross profit of £30,915, and a net profit of £17,880. For the preceding twelve months there was a net loss of £5657. The total cost of the 28,166 tons of coal carbonized in the past year, delivered at the works, was £39,557—equivalent to an average cost of 28s. 1d. per ton, against 48s. 9d. the year before. The total quantity of gas made was 519,162,000 c.ft., a decrease of 6·6 p.ct. The unaccounted-for gas was 5·77 p.ct., as compared with 6·1 p.ct. There are now 15,895 consumers, of whom 9205 are provided with prepayment meters. The average consumption per ordinary meter was 31,564 c.ft., and per prepayment meter 25,830 c.ft.

The vertical-retort installation at Brierfield has been in continuous use during the past seven years. The time has therefore arrived when the efficiency of the plant requires attention. With this object in view, two ovens are at present being reconstructed. The length of the retorts will be increased by 4 ft. 6 in., and the design at the base of the retort altered, which modifications will give an increased make of gas per setting. When the five ovens are completed, the capacity of the plant will be increased by a million c.ft. per diem. The repairs to the Nelson installation carried out last season, including the resetting of two ovens on a new form of heating, have proved most satisfactory.

Hitherto the high-pressure lighting system had been confined to the centre of the town; but, owing to the popularity of this system, rapid strides have been made during the past lighting season. Due to the encouragement given by private consumers for shop lighting, high-pressure mains have been laid in all the principal streets.

A "Columbus" coke separator has been installed during the year for the prevention of needless waste. It has been a matter for regret that in years past all ashes from the furnaces of the regenerative settings, containing a high percentage of usable coke, should have gone to the

refuse tip. The above plant accomplishes the required salvage, and recovers the usable coke, which is suitable for the producers and boilers (equal to 43 p.ct.), and liberates the same weight of fresh coke for sale. The effective saving from this plant will be £540 per annum.

In some general remarks, Mr. Mitchell says: It will be admitted that the results for the past year are very satisfactory. While the profit on the year's working appears high taking into account the decrease in consumption, amounting to 6 6 p.ct., or £13,000, the gain can only be attributed to reduced expenditure, together with more economical working and better results obtained from the various plant introduced during the past three years. After present improvements are completed, a further saving amounting to approximately £2500 per annum will be effected.

It is pleasing to recall that no labour troubles of a serious nature have interfered with the smooth working of the department.

Wandsworth Company's Further Reduction.—The Directors of the Wandsworth, Wimbledon, and Epsom District Gas Company have notified a reduction in the price of gas of three-fifths of a penny per therm (which is approximately 3d. per 1000 c.ft.) from the date of the reading of the meters at Midsummer. The reduction will apply to the whole of the district supplied by the Company.

Bombay Gas Company, Ltd.—The Directors will report at the meeting of shareholders to-morrow (Thursday) a profit for the year ended Dec. 31, as shown by the net revenue account, after allowing for interest and exchange, amounting to £31,081, making, with £25,824 brought forward from the preceding year, £56,905 available for dividend. Deducting the interim dividend paid in November last (£11,200), and placing £829 to the reserve fund, £553 to the renewal fund, and £99 to the insurance fund, there remains £44,223, out of which the Directors recommend a dividend of 4 p.ct. (less income-tax), making 8 p.ct. for the year. This will leave £33,023 to be carried forward. In accordance with the Articles of Association, the Directors have appointed Mr. Hugh Henderson Macleod to be a Director.

Cheadle Council to Buy Gas-Works.—Mr. F. S. Cox (Clerk) reported to a meeting of the Cheadle Rural Council last week that he had had an interview with the officials of the Ministry of Health and Board of Trade with reference to the Council's application for an Order investing them with urban powers, to enable them to purchase the Cheadle gas undertaking, and for sanction to a loan of £10,000. The Departments concerned were willing to give the required powers. It would be necessary to make application to the Board of Trade for an Order under the Gas Regulation Act, fixing a new maximum price; and they would favourably consider the issue of one for a maximum price per therm equal to 6s. 8d. per 1000 c ft. The Clerk also reported that he had had an interview with the Receiver of Amalgamated Industrials, Ltd., and had tentatively agreed that the undertaking should be transferred on June 30. His action was approved.

TRADE NOTES.

"F.A." Stoking Machines.

Messrs. Aldridge and Ranken, Ltd., of No. 39, Victoria Street, Westminster, S.W. 1, have received from the Southend Gas Company an order for one of their central chain type "F.A." stoking machines. The present machine in use at the Southend Gas-Works started work in October, 1909.

Joseph Dixon Crucible Company.

The Joseph Dixon Crucible Company announce price-reductions on all Dixon's graphite products (with the exception of paint) on and from May 1 last. This is the third price-reduction since 1920, and now brings Dixon's specialities down practically to pre-war prices. Consumers of Dixon's products are ensured of getting the same high quality that has characterized the Company's goods for nearly a century.

The Gunfire Controller.

We have been informed by the Automatic Light Controlling Company, Ltd., of Bournemouth, that the progress which is being made by this firm is well illustrated by the fact that, quite recently, repeat orders have been received from Birmingham, Southport, Elgin, Folkestone, Gourock, Bolton, Edinburgh, Sheffield, Broadstairs, Middlesbrough, Sowerby Bridge, and Weston-super-Mare. These orders amount to several thousands of controllers.

Fuel Economy.

An analysis of the orders received during the past month shows that a number of industries in different countries have placed on record their faith in the "Turbine" patent furnace, manufactured by the Turbine Furnace Company, Ltd., of Gray's Inn Road, W.C. The Company are showing at both the Laundry and the Mining Exhibitions, at the Royal Agricultural Hall, Islington, May 9 to 16 and June 1 to 14 respectively. For Canada (Vancouver) eight sets of furnaces for Babcock & Wilcox boilers are required. Many of the orders sent in are repeat; and as far as the Turbine Furnace Company are concerned, business is exceedingly good—a sure indication that trade generally is increasing.

At Lytham St. Annes Town Council, on Monday, it was reported that the profit on the two gas-works in the borough for the past year was £23,704.

A quantity of tar became ignited at the Sunninghill works of the Ascot Gas and Electricity Company. Realizing the immediate danger of the works, one of the officials obtained a stock of patent extinguishers from the Sunninghill Picture House, while an urgent message was sent to the Ascot Fire Brigade. Fortunately the extinguishers did the work, and the flames were driven back and eventually overcome.

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THE NORTH-EAST COAST COAL TRADE.

From Our Own Correspondent.

The Newcastle market has not undergone any marked change during the past week. On Tuesday, the May Day holiday materialized as far as Durham was concerned; and very few collieries could report having drawn any quantities of coal worth mentioning. In Northumberland, however, wiser counsels prevailed, and practically a normal day's output was reached. The effect of the loss of a day's coal in Durham naturally has made the position for prompt supplies tighter than ever, and there is still the greatest difficulty in getting tonnage stemmed for the whole of May. Indeed, practically the only new business passing is in very small odd lots to complete cargoes; and shippers are frequently going the rounds trying to find small quantities of fifty or a hundred tons.

The position is extremely strong up to the end of next month, with very little coal offering. It is distinctly firming up as far ahead as end September, and there is not much discount as far as that on current prices. More business has been placed to the end of the year at 32s. 6d., and for twelve months July-June at round 28s. But on the whole, buyers are still rather holding off for anything beyond June. With no obvious change in the Ruhr situation, collieries are quite content to hold their available coal, rather than come down to quotations which would bring business from the numerous inquiries which are circulating. Coking coal is still in greatest demand, up to 37s. being obtainable for good qualities.

Recent quotations for gas coal still hold—35s. f.o.b. for Wear Specials and best qualities (Holmside, Boldon, New Pelton class), and about 32s. 6d. for seconds. Bests could probably be obtained at these prices for July September; while collieries would perhaps quote 32s. 6d. to the end of December, and somewhere about 28s. for twelve months.

YORKSHIRE AND LANCASHIRE COAL TRADE.

From a Local Correspondent.

Owing to the operation of the Summer Time Act and to the warmer weather, the demand for gas coal has not been as heavy as usual, though collieries are fully booked ahead in other directions, and there are no supplies available. The requirements for export are still extensive; and with the position in the Ruhr remaining unsettled, there are urgent requests from Germany and Belgium for increased tonnages, even for some months ahead. This has brought about a shortage of coal available for English industries; and although there does not appear to be any improvement in the local trades, many large firms are clamouring for the necessary fuel to keep their works running. At Barnsley, on Friday, it was reported that the supply of large steams had been maintained; but prices were easier at 33s. to 33s. 6d. per ton f.o.b. for early delivery. A fairly large tonnage under contract is being taken by Norway and Sweden. The electricity plants are taking a big bulk of best slacks, and coking smalls are in full demand.

COAL TRADE IN THE MIDLANDS.

From Our Local Correspondent.

Though it is admitted that the falling off in shipments of coal and coke across the North Sea has given a tactical advantage to home consumers, the collieries are not moved by the pressure of lower prices. Their case is that the foreign demand is still urgent, and that it is really its magnitude, not its diminution, that is responsible for the change noticed in recent weeks. The facilities for loading and unloading have been so severely strained, they say, that congestion has resulted at the ports. They predict that as this is overcome, the volume of exports will advance again. Meanwhile they adhere to their prices; and the upward movement of wage rates has a steadying effect. In the Warwickshire and Cannock Chase district, miners receive an advance of 9·31 p.ct. Buyers are loth to accept the conclusion that the falling off in the export trade is due to temporary disorganization of transport. They argue that, whatever comes of the fresh parleying with regard to the Ruhr, Continental industrialists cannot afford to fuel themselves from this country on anything like the terms that have lately ruled. As to whether in such an event a corresponding relaxation of the stringency in the Home market is to be expected, is another matter. Buyers believe, however, that the scale will now swing in their favour; and they are awaiting developments.

Coke is not quite so scarce, but values are upheld.

Blackburn Gas-Works Extensions.—In the Blackburn Town Council last Thursday, the report of the Gas Engineer (Mr. G. P. Mitchell) upon the question of increasing the carbonizing plant and the installation of waste-heat boilers at the Greenbank Gas-Works, was considered, with an estimate of the cost. It was resolved that the estimate be approved.

Blackpool Gas Engineership.—The Blackpool Gas Committee have placed on record their appreciation of the services of the late Mr. William Chew, their Gas Engineer, and decided to advertise for a successor at a salary of £800 per year. At the subsequent Town Council meeting, the salary was described by Mr. Swarbrick as paltry, and one which would only attract junior members of gas-works staffs. Mr. P. Tomlinson (the Chairman of the Gas Committee) said he did not favour such a low salary, and thought it would make Blackpool look ridiculous. Only six members of the Committee attended when the matter was discussed. The question was referred back for further consideration.

Special Notice

may we direct your attention to the useful reminders given on each monthly "full" page advertisement in our recently issued "Desk pad"

R. & J. DEMPSTER, LTD. MANCHESTER

STOCK MARKET REPORT.

The Stock Exchange week was cut in two by the annual closure on May Day. Settling down to work on Wednesday, the majority of markets found things dull, with a drooping tendency. Some improvement, led by the gilt-edged force, was initiated next day; but on Friday a wave of profit-snatching supervened, and so the week closed. Home Governments, Home Rails, and the Foreign Market gave way.

Business in the Gas Market pursued its own course undisturbed and active, and again the number of issues advancing their quotations showed no falling off either in the aggregate or in degree. In the London Companies, Gas Light preference, South Metropolitan preference, and Commercial debenture rose 1 each. In Suburban and Provincials, Alliance and Dublin rose 3, Brentford "A" 2, ditto "B" 3, Brighton original 2, Newcastle 2, North Middlesex 1⅛, Plymouth 6, Southampton 4, Swansea debenture and Wandsworth debenture 2 each. Abroad, European rose 1, Hong Kong 5⅛, Oriental 3½, and San Paulo debenture 1½.

The following transactions in gas during the week were recorded: On Monday, Alliance and Dublin 67, Brighton and Hove "A" ordinary 133½, 134. British "A" ordinary 13. Commercial 4 p.ct. 98⅜, European 8⅞, 9⅛, 9⅛, 9⅜, 9⅛, 9⅜, 9⅞, 10⅛, Gas Light ordinary 99½, 99⅝, 99¾, 100, 100⅛, 100⅜, 100⅜, ditto 3½ p.ct. maximum 67½, ditto 4 p.ct. preference 80. 81½, 82, ditto 3 p.ct. debenture 63, Imperial Continental 168¾, North Middlesex ordinary 12½, 12⅝. Primitiva 5 p.ct. preference 38s. 9d., South Metropolitan 100¾, ditto 6½ p.ct. debenture 106⅞, 107, South Suburban 101, Southampton 5 p.ct. maximum 92, Tottenham "B" 105, Barnet "C" 158½, British "B" 12¼. Hampton Court 5 p.ct. 110, 110½, Hornsey 4 p.ct. debenture 77½, Wandsworth 5 p.ct. preference 99½. On Tuesday, the London Exchange was closed. On Wednesday, Alliance and Dublin 66½, 67, Brentford "A" 103, British "A" ordinary 13, Commercial 4 p.ct. 98⅜, European 9⅜, 9 15/16, 10. Gas Light ordinary 100, 100⅛, 100¼, 100½, 100⅜, ditto 3½ p.ct. maximum 67½, ditto 4 p.ct. preference 81½, 81⅛, ditto 3 p.ct. debenture 62⅜, 63⅜, 64, 64⅛, Hastings and St. Leonards 3½ p.ct. 77. Imperial Continental 167, 167½, 168, 168½, Primitiva 5 p.ct. preference 39s. 6d., South Metropolitan 99⅜, 100, ditto 3 p.ct. debenture 64, ditto 6½ p.ct. debenture 106½, Wandsworth new 102½, 103, ditto 3 p.ct. debenture 60, British "B" 12¼, South Suburban 7 p.ct. debenture 102, Danish 4 p.ct. debenture 73. On Thursday, Alliance and Dublin 67⅛, 67½, Brentford "A" 104, Bristol 93½, ditto 4 p.ct. debenture 74½. Commercial 3½ p.ct. 99, Continental Union 29, European 10, 10 1/16, Gas Light ordinary 99⅜, 100, 100⅛, 100¼, 100⅜, 100½, 100⅝, ditto 3½ p.ct. maximum 68, ditto 4 p.ct. preference 81⅛, 81⅜, ditto 3 p.ct. debenture 63⅜, Liverpool ordinary 90, 90½, North Middlesex 12½, 12 5/16, Primitiva 10s., ditto 5 p.ct. preference 39s. 6d., ditto 1911 debenture 57½, South Metropolitan 99⅜, 100⅜, South Suburban 101⅜, Barnet 4 p.ct. debenture 79, Croydon 7½ p.ct. preference 105, Hartlepool 5 p.ct. 91½, Lea Bridge 7½ p.ct. debenture 107½, 108½, Uxbridge, Wycombe, and District 4 p.ct. debenture 78. On Friday, Aldershot 4 p.ct. preference 77, 77½, Alliance and Dublin 67, 67¼, 67 1/16. British "A" ordinary 13, European 9⅜, Gas Light ordinary 100, 100⅛, 100⅜ ditto 4 p.ct. preference 81⅜, 82⅛, Imperial Continental 167, 168½, ditto 3½ p.ct. debenture 76½, 77, 77½. Monte Video 64. Oriental 101, Primitiva 10s., ditto 5 p.ct. preference 38s., 39s. 6d., South Metropolitan 99⅜, 100¼ Wandsworth New 103, British "B" 12, Cheltenham 5 p.ct. max. 67, 67½, ditto 4 p.ct. debenture 63½, 64.

In the Money Market, there was a more healthy atmosphere, and a return to something like reasonable rates appeared in view. Firmness, being once re-established, steadily held on till the close. Discount terms pursued a like course. Silver scarcely varied at all. The Bank of England rate was 3 p.ct., as fixed on July 13.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S TRANSACTIONS.

Issue.	Share.	When ex-Dividend.	Ante-War Dividend & Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Present Prices.	Lowest and Highest Prices of Transactions.
£			p.c.					
131,978	Stk.	Feb. 22	—	5%	Aldershot 5 p.c. max. C.	..	74—79	...
190,492	,,	,,	4	4%	Do. 4 p.c. Pref.	..	70—75	77—77½
1,551,868	,,	Apl. 5	2½	5%	Alliance & Dublin Ord.	59—64	65—70	66½—67 1/16
374,000	,,	Jan. 11	4	4%	Do. 4 p.c. Deb.	76—79	60—65	...
280,000	5	Oct. 19	7½	4/-	Bombay, Ltd.	5⅛—6⅛	4⅛—5⅛	...
100,000	5	Feb. 22	16	8/-	Bourne-mouth Gas and Water: 5 p.c.	..	11—11⅛	...
383,110	10	,,	7	7/-	Bourne-mouth Gas and Water: B 7 p.c.	15—15½	11⅛—12⅛	...
115,000	10	,,	6	6/-	Bourne-mouth Gas and Water: Pref. 6 p.c.	13½—14	10—11	...
162,065	—	Dec. 29	—	4%	Bourne-mouth Gas and Water: 4 p.c. Deb.	..	71—76	...
992,045	Stk.	Feb. 22	14	6⅛/-	Brentford A Consolid.	261—266	102—107	103—104
734,920	,,	,,	11	6⅛/3	Do. B New	204—209	100—105	...
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109—111	85—90	...
221,400	,,	Dec. 14	4	4%	Do. 4 p.c. Deb.	91—93	78—83	...
214,775	,,	Mar. 8	11	11%	Brighton & Hove Orig.	208—213	175—180	...
244,200	,,	,,	8	8⅛%	Do. A Ord. Stk.	154—159	130—135	133½—134
1,272,500	Stk.	Feb. 22	5	5%	Bristol 5 p.c. max.	..	90—93	93½
570,000	20	Mar. 22	12½	10/-	British A Ord.	44—45	12½—13½	13
10,000	10	Dec. 29	—	7/-	Do. 7 p.c. Pref.	..	12—13	...
120,000	Stk.	June 29	4	4%	Do. 4 p.c. Deb. Stk.	88—90	75—80	...
220,135	,,	Dec. 29	4	4%	Buenos Aires 4 p.c. Deb.	85—87	55—58	...
100,000	10	Nov. 2	—	—	Cape Town & Dis., Ltd.	1⅛—2⅛	6⅛—7⅛	...
100,000	10	May 3	—	4/6	Do. 4½ p.c. Pref.	4—6	6—7*	...
100,000	Stk.	Dec. 29	4½	—	Do. 4½ p.c. Deb. Stk.	70—75	72—77	...
237,860	,,	,,	—	7½%	Cardiff 7½ p.c. Deb.	..	107—112	...
157,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108—110	..	...
1,513,280	,,	Mar. 8	5/9/4	6s/-	Commercial 4 p.c. Stk.	106—108	97—100	98⅜
560,000	,,	,,	5⅛	6o/-	Do. 3½ p.c. do.	103—105	97—100	99
475,000	,,	Dec. 14	3	3%	Do. 3 p.c. Deb. Stk.	69½—71½	57—62	...
800,000	,,	Dec. 15	4	—	Continental Union, Ltd.	76—79	27—32	29
200,000	,,	Dec. 14	7	4%	Do. 7 p.c. Pref.	115—118	57—62	...
660,000		Mar. 8	—	6%	Croydon sliding scale.	..	100—103	...
284,975		,,	—	5%	Do. max. div.	..	83—86	...
492,270	Stk.	,,	6	4½%	Derby Con. Stk.	123—125	..	...
55,000	,,	—	4	4%	Do. Deb. Stk.	102—104	..	...
209,000	,,	Apl. 5	—	5%	East Hull 5 p.c. max.	..	..	...
2,002,180	10	Jan. 25	10	5/o	European, Ltd.	17½—18	9½—10½	8⅞—10½
16,146,120	Stk.	Feb. 8	4/17/4	52/-	Gas Light: 4 p.c. Ord.	98—102	99—101	99—100⅝
2,600,000	,,	,,	3½	35/-	Gas Light: 3½ p.c. max.	76—79	66—68	67½—68
4,062,235	,,	,,	4	4%	Gas Light: 4 p.c. Con. Pref.	96—99	81—83	80—82½
4,761,930	,,	Dec. 14	3	3%	Gas Light: 3 p.c. Con. Deb.	72½—74½	62—65	62⅛—64⅛
130,000	,,	Dec. 11	10	10%	Coke: 10 p.c. Bonds	..	..	...
—	—	—	—	—	Coke: 7½ p.c. Ilford Deb.	..	..	...
82,500	,,	Mar. 8	5	65/7½	Hastings & St. L. 5 p.c.	..	92—97	...
258,740	,,	,,	3½	50/7½	Do. 3½ p.c.	87—89	75—78	77
70,000	10	May 18	11	10%	Hongkong & China, Ltd.	16½—16¾	14—16	...
86,600	Stk.	Mar. 8	9	9⅛%	Hornsey 7 p.c.	..	147—152	...
1,976,000	,,	Nov. 16	9	£5	Imperial Continental	150—160	165—170	167—168½
404,800	,,	Feb. 8	3½	3½%	Do. 3½ p.c. Deb. Red.	84—86	75—78	76⅛—77⅛
235,242	,,	Mar. 8	6¾	6¾%	Lea Bridge Ord. 5 p.c.	119—121	93—98	...
2,498,905	,,	Feb. 26	10	37/6	Liverpool 5 p.c. Ord.	..	..	90—90½
600,000	,,	Mar. 22	—	7%	,, 7 p.c. Pref.	..	103—105	...
165,736	,,	Feb. 22	7/5/6	80/-	Maidstone 5 p.c.	..	107—112	...
63,480	,,	Dec. 29	—	3%	Do. 3 p.c. Deb.	..	53—58	...
75,000	5	June 29	6	6%	Malta & Mediterranean Met. of Melbourne: 4 p.c. Deb.	4⅛—4⅜	3⅛—4⅛	...
100,000	100	Apl 5	4½	4½%	Malta & Mediterranean Met. of Melbourne: 4½ p.c. Deb.	99—101	97—100	...
541,920	Stk.	Nov. 30	4	4%	Monte Video, Ltd.	11½—12	60—65	64
1,875,892	,,	Feb. 22	4½	5⅛%	Newcastle & Gatsh'dCon.	98½—99½	85—86	...
250,166	,,	,,	—	4%	Do. 4 p.c. Pref. Stk.	..	76—78	...
529,705	,,	Dec. 29	3½	3½%	Do. 3½ p.c. Deb.	82—83	68—69	...
15,000	10	Aug. 26	—	7/6	North Middlesex 10 p.c.	..	..	...
55,940	10	Mar. 8	7/14/0	7/8⅜	,, ,, 7 p.c.	14—15	12—13	12⅛—12⅜
300,000	Stk.	May 3	8	8%	Oriental, Ltd.	117—122	97—102*	101
188,120	Stk.	Dec. 29	—	72/6	Plym'th & Stonh'se 5 p.c.	..	100—105	...
60,000	50	Mar. 8	13	65/-	Portsea Island, B	128—131	103—108	...
100,000	50	,,	12	60/-	Do. C	118—121	100—105	...
290,069	5	—	8	—	Primitiva Ord.	5⅛—6	⅜—⅝	10/-
499,960	5	—	5	—	Do. 5 p.c. Pref.	4⅛—5	1⅛—2⅛	38/—39/6
521,800	100	Nov. 30	4	4%	Do. 4 p.c. Deb.	91—93	70—73	...
600,000	Stk.	Jan. 25	4	4%	Do. ,, ,, 1911	..	55—58	57⅛
346,198	,,	Dec. 29	4	4%	River Plate 4 p.c. Deb.	85—87	55—58	...
150,000	10	Mar. 22	6	6/-	San Paulo: 6 p.c. Pref.	10½—11	5⅛—6	...
125,000	50	July 3	5	5%	San Paulo: 5 p.c. Deb.	47—49	38—41	...
135,000	Stk.	Mar. 22	10	5%	Sheffield A	223—224	96—98	...
209,984	,,	,,	10	5%	Do. B	222—224	96—98	...
525,500	,,	,,	10	5%	Do. C	220—222	96—98	...
133,201	Stk.	Sept. 15	4	4%	Shrewsbury 5 p.c.	..	..	...
90,000	10	Nov. 2	9	7%	South African	10½—11½	7—9	...
6,609,895	Stk.	Feb. 22	5/4/0	60/-	South Met. Ord.	111—113	99—102	99⅜—100⅜
250,000	,,	Jan. 11	—	5%	Do. Red. Pref.	..	97—99	...
1,895,445	,,	,,	3	3%	Do. 3 p.c. Deb.	72½—74½	62—64	64
734,000	,,	Mar. 8	—	6⅛%	Do. 6½ p.c. Deb.	..	105—107	106½—107
91,500	,,	Feb. 22	8½	8⅛%	South Shields Con. Stk.	157—159	115—117	...
1,087,795	,,	,,	6	6%	S'th Suburb'n Ord. 5 p.c.	114—116	99—102	100⅛—101
368,837	,,	Dec. 29	5	5%	Do. 5 p.c. Deb. Stk.	116—118	93—98	...
647,740	,,	May 3	5	7%	Southampton Ord.	99—102	88—91*	92
121,275	,,	Dec. 20	4	4%	Do. 4 p.c. Deb. Stk.	..	68—73	...
250,000	,,	Mar. 8	—	70/-	Swansea 7 p.c. Pref. Stk.	..	102½—104½	...
200,000	,,	Dec. 29	—	6½%	Do. 6½ p.c. Deb. Stk.	..	105—107	...
120,000	,,	Feb. 22	—	7⅛%	Tottenham: A 5 p.c.	135—138	123—128	...
782,275	,,	,,	6	6%	Tottenham: B 3½ p.c.	115—117	102—107	105
181,255	,,	Dec. 14	4	4%	Tottenham: 4 p.c. Deb.	87—89	75—80	...
258,251	Stk.	Mar. 22	5	5%	Tynemouth 5 p.c. max.	108½—109	90—92	...
30,000	,,	Feb. 22	8½	87/6	Wandsworth, Wimbledon, and Epsom—Wandsworth A 5 p.c.	131—136	130—135	...
255,636	,,	,,	6½	72/6	Do. B 3½ p.c.	129—134	115—120	...
18,075	,,	,,	—	61/3	Do. C.	..	100—105	...
140,865	,,	,,	—	61/3	New Ordinary	..	100—105	102½—103
352,000	,,	,,	6½	68/9	Wimbledon 5 p.c.	117—122	109—114	...
98,000	,,	,,	6½	73/9	Epsom 5 p.c.	121—126	115—120	...
88,416	,,	Dec. 29	3	3%	3 p.c Deb. Stk.	66—69	58—61	...

Ex. div.

The British Gas Light Stock Prices.

Sir,—Will you permit me to draw your attention to the fact that the comparison of the present prices of this Company's shares with the pre-war price, as set out in your "Stock Market Report" is somewhat misleading.

On March 21 last, our £20 ordinary shares were sub-divided into two shares of £10 each; and, at the same time, a distribution of a further £10 share was made to each holder of two £10 shares. Hence each holding of one £20 share is now represented by two "A" ordinary shares of £10 each and one "B" ordinary share of £10 (the latter being the distributed share).

After the payment of the next October dividend, the "A" and "B" shares will rank *pari passu*.

The present market value of the "A" ordinary shares is £12½ to £13½ and of the "B" ordinary shares £12 to £13.

A. W. Brookes,
Secretary.

The British Gas Light Co., Ltd.,
2, The Abbey Garden, Westminster, S.W.1,
May 7, 1923.

[This communication will receive the attention of our Stock Market Correspondent next week.—Ed. "G. J."]

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THE FLOW OF GASES and PROPORTIONING GAS MAINS.

By
F. SOUTHWELL CRIPPS, Assoc.M.Inst.C.E.

WALTER KING, Ltd., "Gas Journal" Offices, No. 11, Bolt Court, Fleet Street, E.C.4.

CURRENT SALES OF GAS PRODUCTS.

Tar Products in the Provinces.

May 7.

The average values for gas-works products during last week were: Gas-works coal tar, 106s. 6d. to 111s. 6d. Pitch, East Coast, 172s. 6d. to 175s. f.o.b. West Coast—Manchester, 167s. 6d. to 170s.; Liverpool, 168s. 6d. to 173s. 6d.; Clyde, 170s. to 175s. Benzole 90 p.ct., North, 1s. 6d. to 1s. 6½d.; crude 65 p.ct. at 120° C., 1s. to 1s. 0½d. naked at makers' works; 50-90 p.ct., naked, North, 1s. 8d. to 1s. 8½d. Toluole, naked, North, 1s. 11d. to 2s. nominal. Coal tar crude naphtha in bulk, North, 8½d. to 9d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 10d. Heavy naphtha, North, 1s. 6d. to 1s. 8d. Creosote, in bulk, North, liquid, 8½d. to 8¾d.; salty, 7½d. to 8d. Scotland, 7d. to 7½d. Heavy oils, in bulk, North, 9d. to 9½d. Carbolic acid, 60 p.ct., 3s. 9d. to 3s. 10d. prompt. Naphthalene, £15 to £16; salts, £6 to £8, bags included. Anthracene, "A" quality, 4d. per minimum 40 p.ct., purely nominal; "B" unsaleable.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *May 7.*

On the London market there continues an absence of inquiry for pitch for export this season—indeed, the shipment of the balance for this season is almost completed. In these circumstances the price is quite nominal, and it is possible that even 170s. might be accepted for prompt, if there were buyers. Creosote remains steady at about 10½d. per gallon net and in bulk at makers' works. This product will be scarce for about six months. There is an increased demand for motor benzole, and the price has advanced a little to 1s. 9¾d. net in bulk. Toluole and solvent naphtha are unchanged.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer—not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON TUESDAY, to ensure insertion in the following day's issue.

Orders to Alter or Stop PERMANENT ADVERTISEMENTS should be received by the FIRST POST on Monday.

UNDISPLAYED ADVERTISEMENTS; Situations Wanted, Six Lines and under (about 36 words) 3s.; each additional Line, 6d. Situations Vacant, Apparatus Wanted and for Sale, Contracts, Public Notices, &c., 9d. per Line—minimum, 4s. 6d.

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See Illustrated Advertisement, March 21, p. 792.

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A MANUAL OF USEFUL TABLES FOR THE GAS ENGINEER AND STUDENT.

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